THE WORLD IS ITS FIELD.

THE ENGINEERING MAGAZINE

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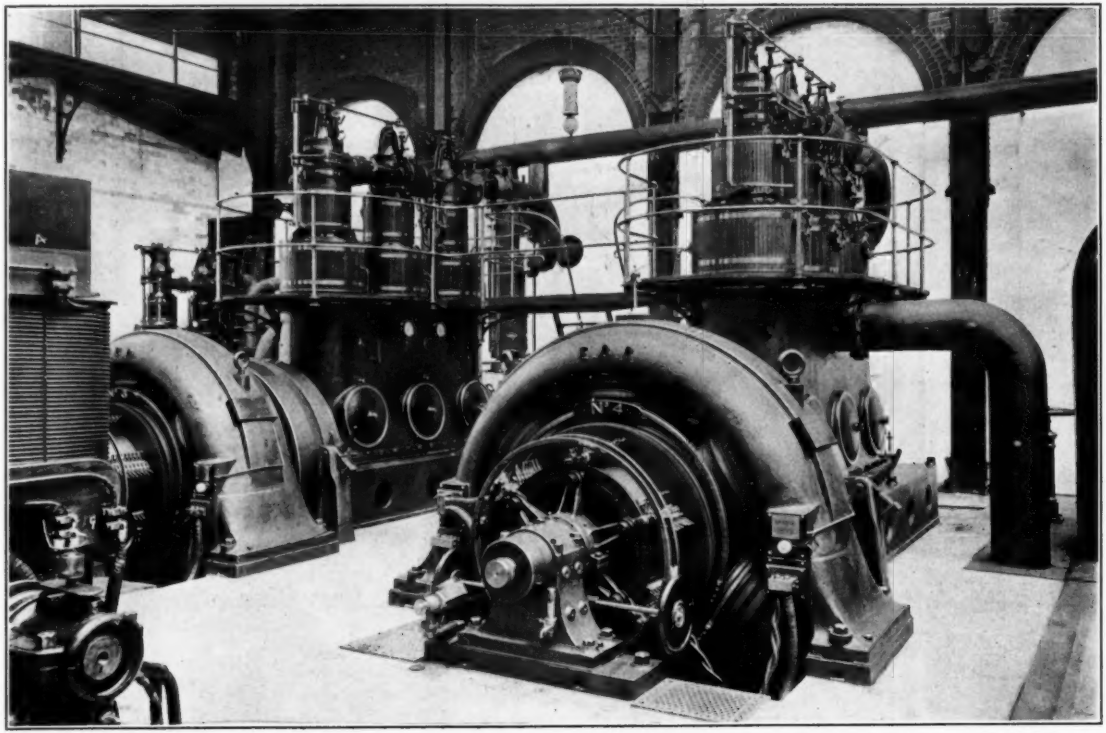
ENGLISH, AMERICAN AND CONTINENTAL STEAM ENGINEERING.

By Philip Dawson.

The most striking result of the spread of international competition in engineering work is the general betterment of practice everywhere. Reciprocity extends to the mutual interchange of that which is best, and common abandonment of that which is inferior. It is a survival of the fittest in which absolute ideals of excellence are fast superseding merely national ideals. The process is still in full progress, and those vitally interested can be best aided by clear knowledge of what is being done abroad in comparison with what is being done at home.

Steam engineering affords a field enormously exceeding all others, and in it the most directly competitive opportunities are found in the large power house. To this Mr. Dawson's articles are devoted. His friendly but fearless criticism and praise make the series, which begins in this issue and will run through four numbers of THE ENGINEERING MAGAZINE, invaluable to designers, builders, or managers of steam-engineering plants.—THE EDITORS.

AT the present time it is no longer possible to doubt the fact that engineering is not confined to any one country or language, but that it is international and knows no boundaries. Community of interests should be freely admitted and no single group of engineers or manufacturers can ever hope to excel at all points. The more it is possible to assimilate the best practice of all countries, the better it will be for the industry. An attempt will be made in these articles to call to the attention of those interested some of the merits and faults which are to be found in steam-engine practice as applied to electric-power plants in various countries. The author has had special facilities for personally investigating the work and progress both in Europe and America, and being a member of most well-known European and American engineering societies has had the



WILLANS ENGINES AT THE CITY AND SOUTH LONDON GENERATING STATION. TWO SETS OF 575 HORSE POWER EACH.

opportunity to appreciate to the full the international hospitality extended by engineers to others all over the world. The familiarity with European languages he trusts may enable him to lay before his readers some points in connection with the subject which may be both interesting and instructive.

Every engineer and manufacturer should strive to be first in his own particular sphere, and rivalry is to be commended and encouraged; but it should be free from jealousy and personal ill feeling. This is a state of affairs which is somewhat difficult of attainment, but the interchange of visits amongst the various engineering associations and the fraternal intercourse which must necessarily take place amongst engineers of all nations is doing much, and will do more, to put matters upon a friendly footing. Frank recognition of merit irrespective of origin is the true and only secret of success, and failing this, no nation, engineer, or manufacturer can ever hope to maintain the leadership.

It may be if interest here to run through briefly the leading characteristics of engineers and their methods, in Great Britain, America, and on the Continent; hereafter we will examine the three sections more minutely.

Broadly speaking the difference between the three types mentioned above is as follows:—

The average English mechanical engineer is a first class mechanic and rarely a business man or a scientist.

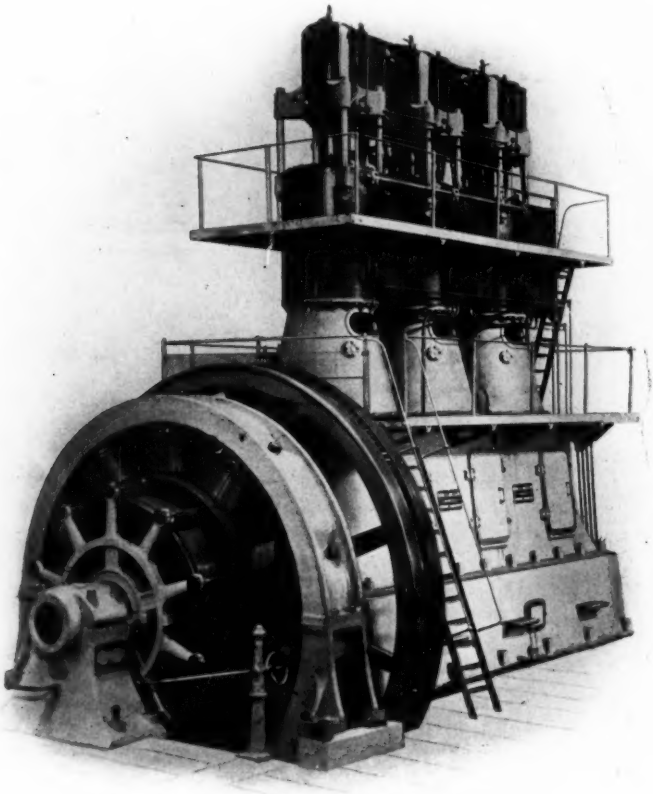
The American engineer is a scientifically trained business man.

The Continental engineer is a highly trained theoretical man.

Great Britain:—A few years ago steam-engine practice would have been classified under the same heads, but with recent years it has become much more alike in all countries.

For many years in England the high-speed high-pressure direct-coupled type was practically the only type of engine used in power stations. This was due to Willans building an engine capable of running at a sufficiently high speed to enable it to drive the then-existing dynamos direct. This type was also partly the result of marine practice, especially of torpedo-boat engines.

United States of America:—In America at the present day, slow-speed Corliss engines are the favourites. Till the World's Fair of 1893, engines were always belted to the dynamos, which were of very moderate dimensions, and liable to frequent breakdowns; hence the practice of using countershaft by which means any engine could drive any dynamo.



BROWETT & LINDLEY HIGH-SPEED 1500-HORSE-POWER SET.
One of eight for the Salford Corporation.

Continent of Europe:—On the Continent of Europe engines driving dynamos either by belts or ropes were preferred to direct coupling, because the former method enabled small cheap dynamos to be used. This is now no longer the case and slow-speed direct-coupled sets are practically universal.

Great Britain was the home of the steam engine. America originated the high-economy, small-clearance, trip-gear type; the Corliss gear, invented by George Corliss and Edwin Reynolds enables cylinder clearance to be reduced to a minimum. The Continent introduced the poppet-valve trip-gear, although this is really only another form of the

Cornish valve. The Sulzer valve was introduced by an Englishman, Mr. Brown (of Sulzer Bros., Winterthur), the father of the well-known electrician, C. E. L. Brown, who is the founder of the celebrated firm of Brown & Boveri, of Baden, Switzerland.

Boiler-house practice of a few years ago was, if anything, more varied still. England was using the Lancashire and Cornish types, Scotland the multitubular wet-or-dry-back marine boiler, America evolved the Babcock & Willcox water-tube boiler, while on the Continent a composite, built-up form of boiler was most common, France using the "elephant" type and Germany a combination of Cornish or Lancashire surmounted by the fire-tube type.

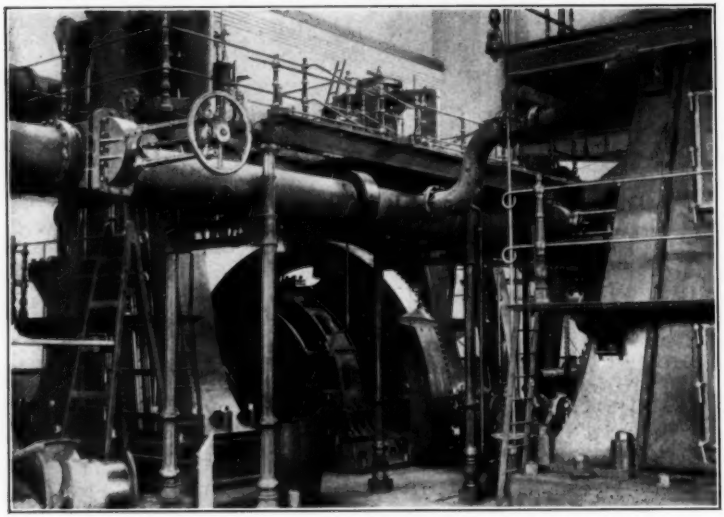
The advent of electric traction and power transmission has done much to internationalise electrical and steam engineering. The electric tramway, first shown by Siemens at the Berlin Electrical Exhibition of 1879 and then installed on the Berlin Lichterfelde tramways, came to England and was adopted on a practical scale by Magnus Volk at Brighton, by Holroyd Smith at Blackpool, by the late Dr. John Hopkinson at Bessbrook-Newry, and by Sir William Siemens at Portrush. Electric traction was, however, developed and brought to perfection in the United States by such concerns as the Bentley Knight, Thomson-Houston, Westinghouse, Edison, and Sprague companies; and most of our knowledge of this subject at the present day comes from the United States.

The transmission of power by means of electricity was first shown at the Vienna Exhibition, where the reversibility of the dynamo was quite accidentally discovered. The first employment of this principle on a large scale, and also the first commercially successful utilisation of polyphase currents, was shown by Von Dolivo Dobrowolski and the Allgemeine Elektricitäts Gesellschaft and Maschinenfabrik Oerlikon at the Frankfort Exhibition in 1891. This was the well known and now classical Lauffen-Frankfort power transmission. The rapid growth of electric traction and power transmission has done much to encourage and develop the construction of the steam engine and the design of large, highly economical units.

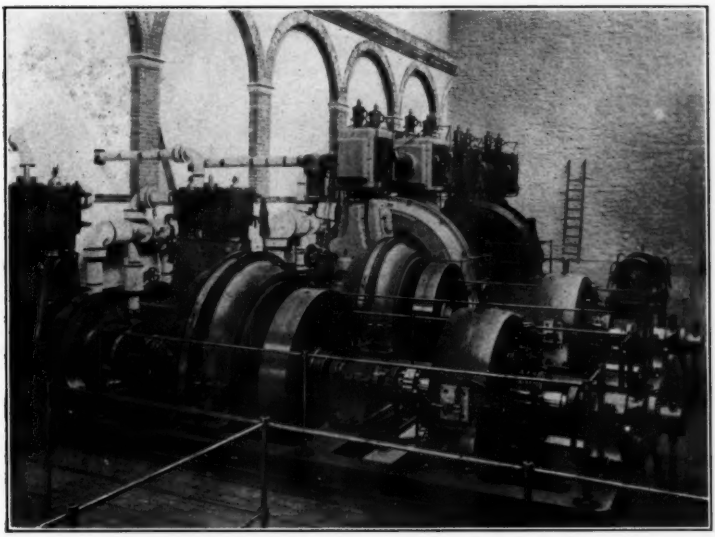
The greatest development of the electrical and allied industries has certainly taken place in the United States, which, as we have seen, although not the birth-place of the industry, has done more than any other country to develop it. Great Britain has always been known as the birth-place of the steam engine, as Thurston shows so well in his history of the steam engine. Newcomen and Watt are household words, and Willans, the inventor of the economical high-speed engine,

is also well-known. The historical side of the subject does not concern us here, however, and we will proceed to examine, as closely as is practicable in the space at our disposal, the different forms of steam-engineering practice which exist in various countries, commencing with Great Britain.

The United Kingdom. Till within the last half-century England had nothing to learn or fear from any other nation; but all that has been changed now, and the sooner she realises the progress which other countries have made and are still making, the better it will be for her. The practice of dispensing with belts, ropes, countershafting and gearing, with their attendant losses and troubles, and coupling the engine direct to the dynamo, originated in England, and most of the credit for this move belongs to Willans. He it was who first built an economical high-speed engine capable of driving the small bi-polar dynamos then in use, dispensing with the necessity of belts to raise the speed, and this type of engine is still one of the most successful at the present day in Great Britain. Willans commenced by building engines for running launches on the Thames, and it is a remarkable fact that nearly all the successful high-speed-engine builders of Great Britain have been connected at some time with marine work. Up till quite recently the small direct-coupled high-speed engine and dynamo was



MUSGRAVE ENGINES AT BOLTON CORPORATION ELECTRICITY WORKS.
1,000 indicated horse power, cylinders 24 and 45 by 42 inches, 100 revolutions per minute.



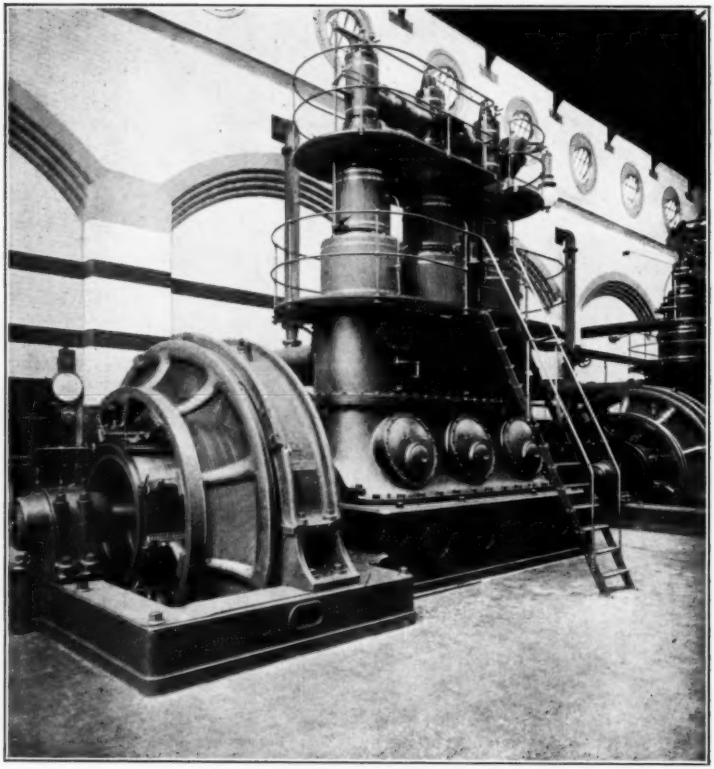
THE PLYMOUTH CORPORATION ELECTRICITY WORKS.

Ferranti engines direct-connected to Ferranti dynamos and Bellis engines direct-connected to Ferranti alternators and Westinghouse direct-current dynamos. By this arrangement the steam engines can be disconnected and the continuous-current dynamos used as motors to run the alternators from a storage battery.

standard British practice. It was also usual to employ Lancashire or Cornish boilers, with a duplicate system of steam and water mains, steel bends, and tees; Hopkinson or Dewrance valves with external screw supported on turned steel columns, and steel cross-head, were nearly universal practice.

The high-speed engines now in use can be classified in two ways, being divided into single and double-acting, or open and closed. A brief description is here given of some typical high-speed engines of British manufacture.

Willans Engine. These engines are single-acting vertical engines, and are made either simple, compound, or triple expansion. The piston rod is hollow and contains the valves, which are of the piston type, all mounted upon one rod which is operated by an eccentric mounted upon the crank-pin. The steam enters the hollow piston rod and is admitted to the first cylinder by the movement of the rod and valves, and exhausts through the piston rod into the next cylinder. In place of the ordinary cross-head and guides, there is a guide piston; on the up stroke of the engine, air is compressed in the space above this piston

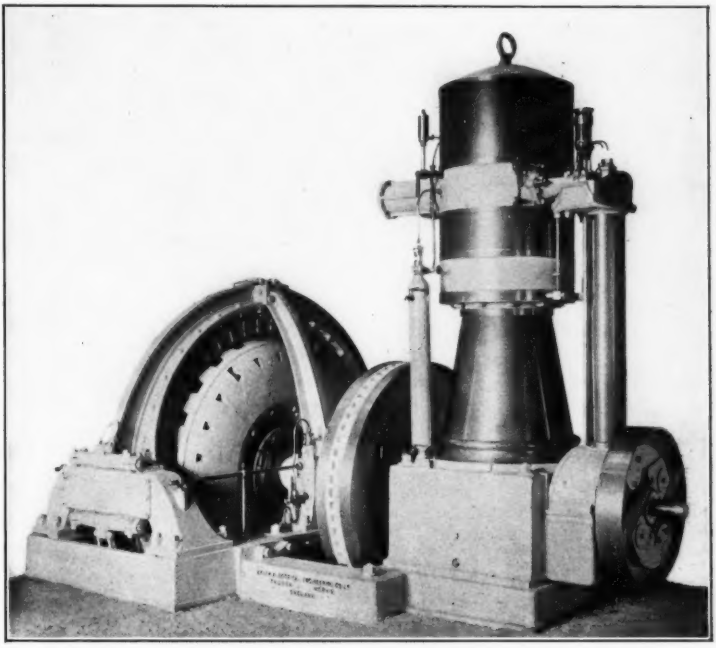


WILLANS ENGINE AND SIEMENS DYNAMO, PUMPFIELDS STATION, LIVERPOOL.
Nine-cylinder triple-expansion, 230 revolutions per minute; cylinders 15, 20½, and 34⅝ inches by 18⅞ inches stroke. Shunt-wound, self-excited dynamo of 1,420 amperes at 550 volts.

and the bottom of the low-pressure cylinder, and thus the pressure in the bearings is never reversed. The great advantage of this is that it ensures complete absence of knock and thus reduces wear to a minimum. The work done in compressing the air on the return stroke is nearly all given out again in the next working stroke, so there is practically no loss. The speed is controlled by a shaft governor operating a throttle valve. All the working parts are completely enclosed.

One great disadvantage of single-acting engines is that for a given power they must have twice the cylinder capacity of a double-acting engine, or must revolve twice as fast, if the cylinder capacity is the same.

The Universal Engine. This engine, designed by Mr. J. S. Raworth, is also of the vertical high-speed single-acting enclosed type, but differs considerably from the Willans. The cylinders are arranged tandem, and the distribution of steam is effected by two Corliss valves placed between the cylinders, by which means clearance is reduced to a minimum. By a special arrangement, the high-pressure cylinder is jacketted inside and outside with steam at the pressure of the receiver, which encloses it. The valves are actuated by ordinary eccentrics, one of which is controlled by a shaft governor.



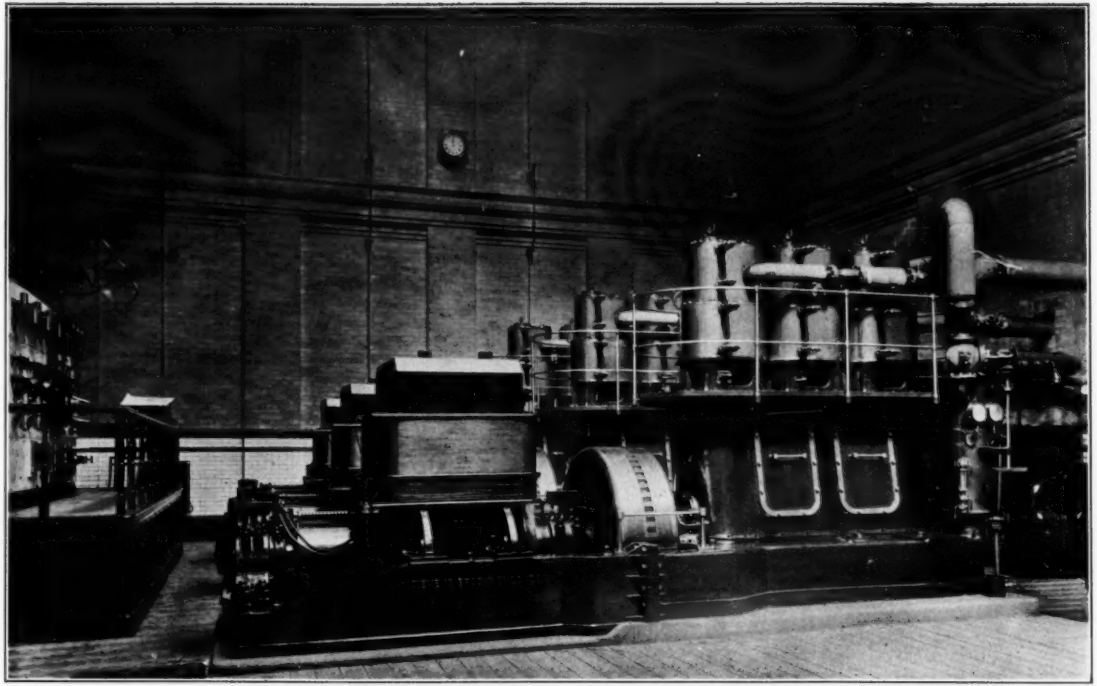
RAWORTH SINGLE-ACTING ENGINE CONNECTED TO BRUSH ALTERNATOR.

Some of the advantages claimed by the makers for the Universal engine are given below.

1. The short steam ports and single-acting cylinders render it highly economical.

2. The working parts are very few in number.

3. The wearing parts are extremely easy of adjustment; the peculiar construction of the connecting rod enables the cross-head and



ENGINE INSTALLATION OF THE HULL ELECTRIC TRAMWAYS CORPORATION.

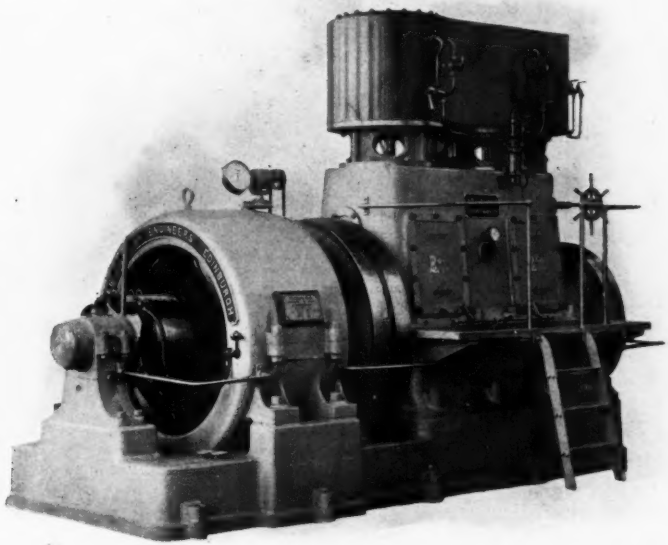
Three Bellis engines of 476 indicated horse power, 360 revolutions, coupled to Siemens bi-polar dynamos of 500 amperes and 500 to 550 volts. Each engine has three cranks, and three sets of two cylinders arranged tandem.

crank-pin brasses to be adjusted at one operation, and with great ease.

4. By virtue of its construction it is naturally self-draining.

5. The single-crank engine gives two impulses per revolution.

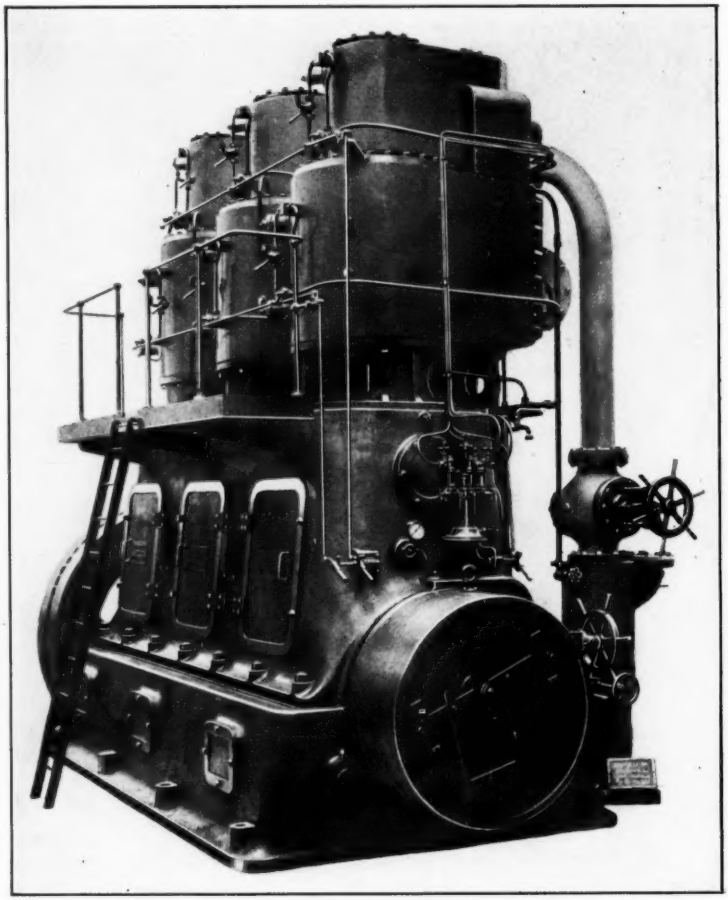
The engine is made with both single and double cranks. The former type ranges in size from 28 indicated horse power, 500 revolutions per minute, and a 5-inch stroke, to 500 indicated horse power, 212 revolutions per minute, and a stroke of 17 inches. The double-crank type is manufactured in sizes ranging from 250 indicated horse power,



BROWETT & LINDLEY HIGH-SPEED 150-KILOWATT ELECTRIC-TRACTION SET.
For Maybank Station, North Stafford Trams.

running at 340 revolutions per minute with a 9-inch stroke, up to 1,000 indicated horse power, running at 212 revolutions per minute and with a 17-inch stroke.

Bellis Engine. The Bellis engine is double-acting, and, by the aid of forced lubrication, has all the advantages of quiet running at high rotative speeds which is possessed by the single-acting engine, with the additional advantage of obtaining extra power for the same cylinder capacity. Although this engine is termed a "high-speed" engine. the piston speed is quite low. The forced lubrication supplies oil to



BROWETT & LINDLEY HIGH-SPEED 1500-HORSE-POWER ENGINE.
For the Liverpool Overhead Railway.

the bearings under a pressure of about 15 pounds per square inch, by means of a simple pump without valves or packing. This pump is worked off the valve eccentric. The two cylinders are side-by-side, with the valves (which are of the piston type) between them. The cranks are set opposite each other, and all of the working parts are enclosed. The cross-head guides are cylindrical and are cast in one with the cylinders.

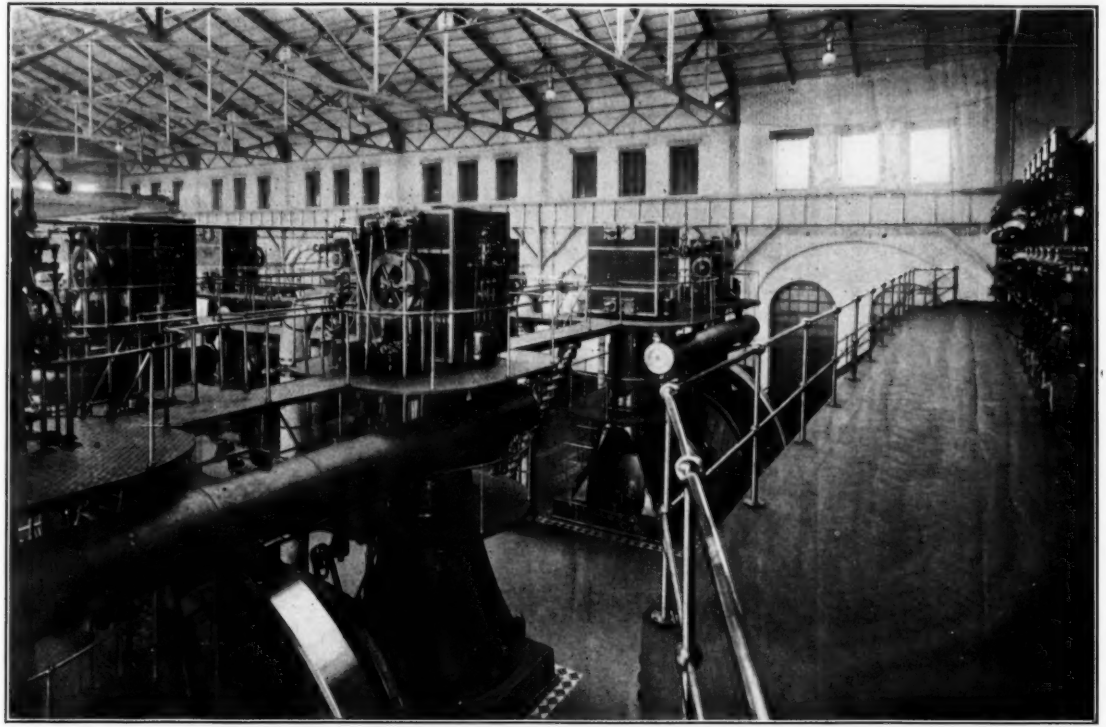
Messrs. Browett, Lindley & Co., Ltd., also make high-speed engines, of the double-acting type, with forced lubrication. The oil is supplied to the bearings under a pressure of about 15 pounds per square inch by means of a small valveless pump. These engines are built in various styles, the most usual being the vertical enclosed type, with two or three cranks. At the Oldham, Ashton, and Hyde traction power-plant there are three of these engines. They are of 650 horse power each, with two cranks, the cylinders measuring 16½ inches and 31 inches by 17 inches stroke. Each engine is equipped with Westinghouse and Rites patent central valve; there are two flywheels, one between the engine and dynamo, 8 feet in diameter and weighing 3 tons, and the other on the outside end of the engine. The latter contains the governor, which is of the Begtrup automatic flywheel type, acting on both cylinders, and controlled by a sliding weight; the speed can be changed from 190 revolutions per minute to 210 revolutions per minute. Forced lubrication is supplied by two sets of oil pumps to each engine, one pump being held in reserve. Each engine is provided with a steam separator, blow-through valves for warming up the cylinders, and water circulation round the slides. The dynamos are of the two-pole type, made by P. R. Jackson & Co., Ltd., and are three in number. Each dynamo is direct-coupled to one of the engines, and has an output of 550 amperes at 550 volts when running at 210 revolutions per minute for traction work, and of 680 amperes at 400 volts for lighting. Messrs. Browett, Lindley & Co. have recently supplied engines of 1,500 horse power for the Liverpool Overhead Railway and Salford Corporation.

The following remarks and suggestions embody all the best points in the present-day English practice in this branch.

The steam valves, high- and low-pressure, should be separate. It is only in one or two makes of the very highest class that single valves between the two cylinders can be kept from passing steam direct from the high-pressure steam space to the low-pressure exhaust. If this does not happen when the valves are new, it frequently develops after running some time, unless the valve packing rings are of a perfectly adjustable type.

The crank pit should be formed into a receptacle for the oil dropping from the working parts, which latter should be completely enclosed, doors being arranged that can be readily opened when required.

A small oil pump should be arranged to work from the crank shaft or eccentric sheave and draw its supply of oil from the crank-pit chamber, a suitable straining device being interposed. This pump should

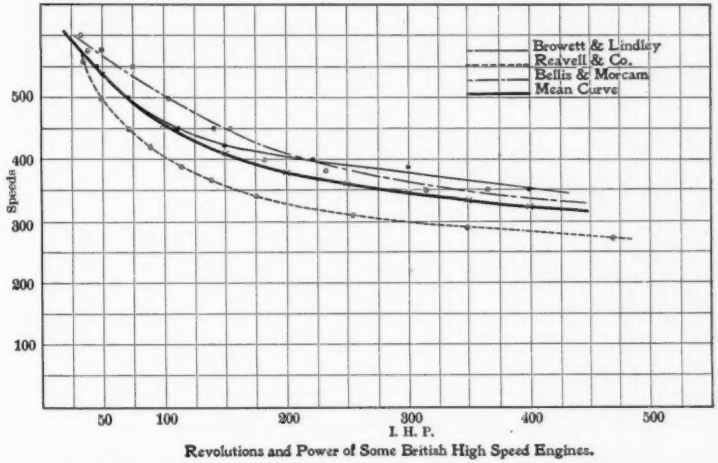


AN ANGLO-AMERICAN INSTALLATION. ALLIS ENGINES AT RINGSEND STATION, DUBLIN UNITED TRAMWAYS.
Six engines, 20 and 40 inches by 42 inches stroke, 800 horse power, vertical cross-compound condensing.

deliver the oil under pressure to the three main bearings and both ends of connecting rods, also to the high- and low-pressure eccentric straps, the pressure required being about 20 pounds.

The cranks should preferably be opposite to one another and do not require to be fitted with balance weights. It is desirable to have oil-throwing rings fitted on the crank shaft, so as to prevent oil travelling on to the dynamo armature.

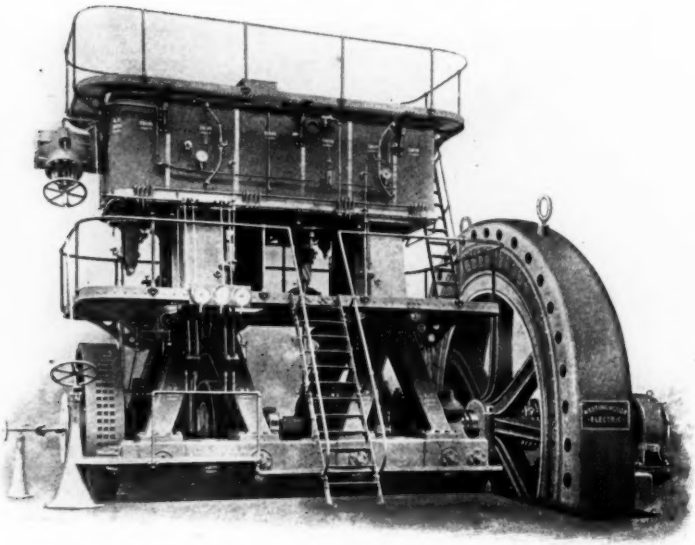
It is found that the regulation and steam economy with high-speed vertical compound engines is quite as good with the throttling type of governor as with the variable-expansion shaft governor. The throttle valve, however, should be most carefully designed, and preferably be of the equilibrium type actuated directly from the crank shaft. A device should be fitted to provide for adjustments while the engine is running. A vertical steam separator should form part of the engine and stand on the same bed.



Revolutions and Power of Some British High Speed Engines.

A small fly-wheel should be provided, preferably with holes bored radially in the rim to permit of barring the engine round when necessary. The engine cylinders should stand above the main casing of the engine, hand holes being provided in the distance pieces so that the glands may be easily accessible. It is preferable to have these packed with metallic packing, especially in the case of the high-pressure cylinder. The type of connecting rod universally adopted for high-speed work in Great Britain is of the marine pattern.

The engine should preferably stand upon a deep section bed, so that



WESTINGHOUSE STEAM ENGINE DIRECT-CONNECTED TO WESTINGHOUSE 2500-HORSE-POWER ENGINE-TYPE GENERATOR.

Metropolitan Electric Supply Co., Ltd., Willesden. Cylinders 35 and 55 inches by 36 inches stroke, 116 revolutions per minute.

the dynamo bed-plate may be bolted directly to it and all rest upon a level foundation, the joint between engine and dynamo beds being made flanged with heavy fitted bolts.

In the larger-sized engines it is preferable to drive each crank by an independent tandem-compound engine, with one throttle valve to control the supply of steam to both high-pressure cylinders, rather than to use one high- and one low-pressure side-by-side. The cross-head guides should be of the bored type and form part of the casting which closes on the top of main casing and supports the cylinders. If adjustment is provided, it should be of the wedge type with all bolts and nuts securely locked to prevent any possibility of these coming adrift in working. Attention should also be given to the position of adjusting screws so that these may be easily "get-atable." Hand holes are frequently fitted to the ends of the engine casing, about the height of centre of slides in two-cylinder engines, for this particular purpose.

The following paper will be devoted to brief description of some of the most important British electric-lighting and traction plants.

THE STANDARDIZATION OF ELECTRICAL APPARATUS.

By J. T. Broderick.

In this article Mr. Broderick supplies the complement to his preceding paper in our October issue setting forth the argument for standardization from the manufacturer's view-point. The key-note of both is the same—economy of energy in the interest of increased and cheapened production. It is a proposition in complete accord with modern industrial evolution, and Mr. Broderick states it clearly, concisely, and convincingly.—THE EDITORS.

A PRECEDING article on the standardisation of electrical apparatus, in THE ENGINEERING MAGAZINE for October, is devoted mainly to a consideration of the questions of cost, delivery, and quality, and of the bearing which these questions have upon the interests of the manufacturer. The object of the present paper is to show, in a general way, how standardization affects the interests of the consumer; the term consumer being used here to denote all classes concerned with electrical apparatus after it leaves the factory.

As costs most directly touch the pocket-book of the manufacturer, so the prices fixed by the manufacturer for his finished product most directly touch the pocket-book of the consumer. The reductions in the prices of electrical apparatus during the past ten years have ranged from 25 per cent. in some instances to 75 per cent. in others. While the influence of competition may to some extent be reflected in these reductions—which may be said to be enormous for so comparatively brief a period—that influence has not been so potent as one at first thought might infer. Competition has sometimes been symbolized as a hammer forcing prices down; but, for reasons which need not be discussed at length here, it is evident that it also tends to keep prices up. Prices, in the electrical or any other industry, cannot be forced below the level of costs without bringing about general demoralization and, for some, financial ruin. It is necessary to go deeper than competition, which,

at the most, is only locally and transiently effective, to account for the result indicated. Prices have been lowered in a great measure because of progress made in simplification and economy of design, of improvements in methods of manufacture, and of increased efficiency of labor. The progress on the score of design has resulted from the concentration of engineering effort on types and sizes standardized either by selection based on anticipated requirements or by the process of natural selection; and the improvements in methods of manufacture, with the increased efficiency of labor, have, in turn, been rendered possible only because these types and sizes—gradually improved in design—have been built in ever increasing quantities. Any reduction in prices effected by such means as these never suggests the unpleasant idea of loss to someone; it is beneficial to the consumer, and at least not injurious to either the manufacturer or his workmen.

The importance to the consumer of the prompt fulfilment of promises of delivery will be at once acknowledged. Time is one of the principal elements in every business calculation. Failure to start a street railway or the machinery of a mine or mill at an appointed date, because of delay in the installation of the electrical equipment, occasions great inconvenience where it does not entail serious loss. As apparatus of standard types and sizes is kept in stock, it may always be ordered with the assurance that it can be delivered when needed. Special apparatus must be built to order, and, as stated in substance in the previous article, while the manufacturer is usually able to estimate the period within which it can be produced, his estimate, however conservative, may be exceeded because of extra time consumed in carefully working out the new features of design called for, of minor changes in the specifications found necessary after the order has been placed, of contingencies in the manufacturing stage, and of unexpected delays in securing raw material. The time consumed in the work of installation is also less with standard than with special apparatus, inasmuch as information relative to the adaptation of engines and foundations is more available.

Of quite as much moment to the consumer as the assurance of a reasonably low initial outlay and prompt delivery is the assurance that his apparatus will operate satisfactorily after it has been installed. A standard machine suggests no uncertainty so far as satisfactory operation is concerned. The mere fact that it *is* standard—provided, of course, it be the product of a reputable manufacturer—constitutes as strong a guarantee on the score of operation as any formal one that could be given. It is built under the most favorable conditions, its

construction embodies the best features of electrical and mechanical design, and its prototypes have been tested in actual service. It represents problems solved, difficulties encountered and overcome; it is an evolution—the outgrowth of experience, the crystallization of the ideas of many alert and painstaking workers. A special generator or motor, by reason of its being the first of its kind built, is in some respects an experimental machine. The utmost care may be exercised and the latest available data be applied in its design and construction, and it may pass a rigid inspection and fulfil specified requirements under test. But in spite of all this, the fact remains that it is a new development; and in the nature of the case it stands at a disadvantage as compared with a machine which is the result of years of effort and of which many duplicates are already performing satisfactory service —it cannot be installed with the same assurance that no feature of design or construction essential for perfect operation will be found lacking.

It will be observed that prices, deliveries, and operation in service have thus far been considered with reference only to their bearing on an original installation. A study of standardization from the viewpoint of the consumer would be very incomplete if it failed to touch upon the feature of interchangeability. The question of maintenance, if anything, is more important than that of the initial investment; one is always present while the other is settled when the conditions of the contract with the manufacturer are fulfilled. Renewal parts for a standard machine are less expensive than similar parts for a special machine, because their manufacturing cost is lower and because less skill is required to put them in place; the likelihood of securing them promptly is greater, because they are more likely to be kept in stock; they may be ordered with more assurance that they will prove satisfactory, for the simple reason that they are for a standard machine whose characteristics and properties are more familiar to the factory engineers and mechanics than are those of a special machine. The longer a special machine has been in service, of course, the more perplexing the problem of making repairs is likely to be. If its construction happens to embody features departing radically from the lines on which progress has been made—the lines of evolution—important renewal parts may be as expensive as a complete standard machine of modern construction, for the reason that the drawings and patterns of the old special machine, as well as the peculiar devices used in its manufacture, may have been destroyed or lost.

No attempt has been made in the foregoing paragraphs to be spe-

cific, although the facts presented may be readily applied to individual cases by those who have had experience in purchasing and installing electrical apparatus. A certain amount of generalization has been deemed necessary in order to establish a point of view from which the buyer and the maker may perceive how identical, in the long run, are their interests and how essential, on their part, is complete and hearty co-operation. The need of explicit suggestions, in dealing with a subject so broad as standardization, is fully realized.

The apparatus which the manufacturer considers standard and which, therefore, is built in large quantities and carried in stock, is usually shown in his catalogues and price lists. As already indicated, this apparatus costs less than unlisted or special apparatus; it can be furnished in shorter time, and it is more likely to prove satisfactory in operation. A greater amount of thought has been bestowed upon its design than it is practicable to give—assuming the fulfilment of reasonable dates of delivery—to any new designs that may be specified. The buyer, therefore, while incidentally best serving the interests of the manufacturer, can at the same time best serve his own interests by consulting the publications referred to and making his selections therefrom whenever his requirements are such as to render this course permissible. He will sometimes find it to his advantage even to go out of his way in an endeavor to make standardized apparatus answer his requirements when it does not seem to be exactly suitable.

When the purchaser is in doubt as to the apparatus best suited to his requirements, consultation with the manufacturer cannot fail to prove beneficial. This aspect of the subject is dealt with in a clear and interesting manner in the following paragraph quoted from a paper read before the New York Electrical Society, Jan. 12, 1898, by the late S. Dana Greene:

> "The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent, and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two, and I can say frankly that I believe he has a proper and permanent field of usefulness. Broadly speaking, his function is to see that his client who buys apparatus and installs it selects first that system best suited to his particular local conditions, and then, in purchasing, secures the best (not necessarily the most,) for his money. It is equally the duty of the consulting engineer to learn what the manufacturer can reasonably be called upon to make, to consult with him freely, and to obtain the benefit of his experience; to give him credit for work well-done, and to insist that bad work shall be promptly corrected. Many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper to consult with the manufacturer,

or to examine his plant, or to ask him for information or advice. Their idea seems to be that, by so doing, they may be accused of partiality or undue bias, or with lack of proper care for the interests of the purchaser; or they may feel that it is derogatory to their own dignity as independent engineers. The inevitable result is that specifications often contain provisions which are a source of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages, from either the engineering or commercial standpoint. In fact, some of these provisions are impossible or impracticable of fulfilment; and in such cases the honest manufacturer who wishes to meet the specifications and guarantees required, finds himself forced to ask the engineer or the purchaser (sometimes both) to modify them. This is a proceeding which is always difficult and delicate to undertake, and often results in friction and trouble for all concerned. I am satisfied that if every consulting engineer would take advantage of opportunities as they occur, to visit manufacturing establishments, to see the work there in progress and to confer with the engineers, he would find himself well repaid for the visit, and his own work and practice benefitted thereby. I am equally satisfied that no reputable manufacturing establishment would refuse admittance, but on the contrary would welcome such visits as beneficial to all parties. The day of mysterious methods of manufacture, carried on behind closed doors, is past in the electrical business, and I appeal with confidence for an endorsement of the opinions just expressed to those consulting engineers who have already tried the plan suggested. I have said that I thought the engineer would find himself repaid by such visits. I think, also, that he will find himself in a better position to advise his client intelligently. A purchaser usually knows little or nothing of the relative technical merits of apparatus, and his final decision is governed largely by price and by paper statements and guarantees, which may mean much or little. The consulting engineer who has seen the apparatus in process of manufacture can advise not only as to whether the various bids comply with the specifications, but also what make or makes of apparatus are, from their design, construction, and factory inspection and test, most likely to give the least trouble and expense in continuous service."

The engineering societies have not overlooked the importance of standardization. The subject has been given much consideration by some of them, notably the American Institute of Electrical Engineers —whose work is briefly referred to in the article previously published —and the American Society of Mechanical Engineers.

The potentials and frequencies standardized by the American Institute of Electrical Engineers may not be familiar to users of electrical apparatus generally, so they are given below:

For direct-current low-tension generators, terminal voltages 125, 250, and 550.

For direct-current and alternating-current low-pressure circuits, terminal voltages 110 and 220.

For direct-current power circuits for railway and other service, voltage 500.

For alternating-current high-pressure circuits, voltages at the receiving end 1,000, 2,000, 3,000, 6,000, 10,000, 15,000, and 20,000.

For alternating-current high-pressure generators, or generating systems, terminal voltages 1,150, 2,300, and 3,450.

A maximum drop in transmission of 15 per cent. of the pressures at the receiving end is allowed in the voltages specified for high-pressure alternating currents.

For alternating-current circuits, frequencies 25 or 30, 40, 60, and 120.

These pressures and frequencies, as far as I am aware, do not correspond in all cases with those which are regarded as standard by any one of the leading manufacturers. They are given here because they comprise the latest recommendations of an impartial scientific body. It is quite likely that the Institute, in its deliberations, had in mind the pressures and periodicities in general use and that it adopted those on which is was possible to secure unanimous agreement. Moreover, a reconsideration of the subject, at the present time, might show the desirability of some modifications and additions.

The Institute, in also carefully explaining and defining such conditions of output as efficiency, rise of temperature, and regulation, has materially aided standardization. It has established a basis from which all manufacturers and engineers may work, and at the same time provided the users of electrical apparatus with accurate and authoritative information on points that in the past have given rise to much confusion, misunderstanding, and friction.

The American Society of Mechanical Engineers saw the necessity, as far back as 1899, of the fullest possible co-operation, on the part of engine and dynamo builders, as to the design and construction of direct-connected sets. These sets constituted a relatively new and at the same time a most important unit brought into the industrial field by the development of the electrical art. Numerous delays and much duplication of effort, arising from a lack of touch between the two classes of builders mentioned, had occasioned both of them a large amount of expense in the aggregate. The American Society of Mechanical Engineers, impressed with this fact, determined to do what it could, in an impartial manner, to bring about an understanding between the different builders with respect to the number and sizes of units suitable for standardization, as well as with respect to speeds, sizes of armature bores, and other features which had given rise to misunderstanding. As a result of its labors, carried on during the past two years, a list of standards is now about to be adopted with the concurrence of the principal builders of steam engines, dynamos, and electrical machinery throughout the United States.

Every manufacturer, in striving to secure the greatest economy in production compatible with high-grade apparatus and prompt deliveries, is naturally forced to give continuous thought on his own account to the standardization of mechanical details, such as shapes and diameters of nuts, screws, and bolts, forms of brush-holders, character of insulating materials and methods of applying the same, and styles of windings. Progress in these details on approximately uniform lines is perfectly feasible wherever features not distinctive and novel enough to be patentable are involved, and in a large sense it must be advantageous to the different manufacturers. The buyer in turn may become a potent factor in such progress with marked benefit to himself by taking the stand—surely a rational one—that the results of experience are likely to be the best and, on principle, avoiding special combinations.

Although, while speaking of the effect of specialization on prices, deliveries, and operation in service, complete new designs have for the most part been contemplated, needless minor variations should not be ignored. The manufacturer, naturally deeming it his duty to be as obliging as possible, is often powerless to resist these variations, which have increased during the past few years at a prodigious rate. Their proper limitation rests largely with the buyer. The arc lamp may be cited to illustrate in a simple manner the point referred to. It would be tedious to enumerate the number of possible variations—as regards finish, method of adjustment, size of carbon, and so on—in this well-known device. Such variations, sufficient in number to cover a wide range of requirements, are of course standard; but any marked increase beyond these, demanded by local companies, industrial managers, and merchants, must clog production, render readjustments in the factory necessary, delay improvements on right lines, and prevent reductions in cost.

It is recognized that progress in standardization is limited by the same conditions that limit any kind of economic progress. Old plants and systems of electrical distribution, representing large investments, cannot be discarded without individual sacrifice, and the continued production of superseded or obsolete apparatus and appliances is therefore rendered necessary. As a result, the benefits which should flow from improvements in design are in some cases neutralized by the increased cost of manufacture due to the multiplication of units required. The history of the alternating current, commercially, affords a striking illustration of this conflict between private interests and general economic progress. The alternating-current and direct-current systems

have always had distinct fields of usefulness; but, with the introduction of the alternating-current system, it was seen that, for some purposes, it was more economical than the older system. It was scarcely to be expected, however, that existing direct-current plants would be abandoned. The direct-current system continued to be used in some cases where it was relatively uneconomical, and the alternating-current system was employed, where it was seen to be superior, for new installations. The effect of all this was to increase artificially the number of variations to be dealt with by the manufacturer. It may be observed, incidentally, that the economical retention of old direct-current plants and the use of the alternating-current system where it is most suitable for new installations have been permitted by means of the rotary converter, a type of machine for changing direct into alternating current or alternating into direct current.

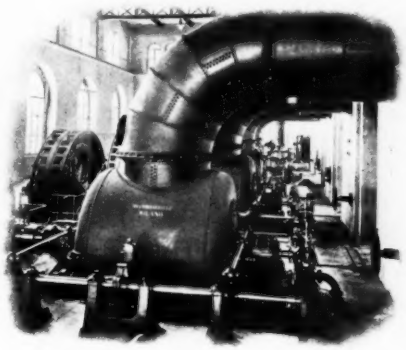
As already stated, where existing installations appear to require obsolete or special apparatus, consultation with the manufacturer is likely to prove of value. It may be found possible in some cases to use standard apparatus, without any temporary sacrifices and, of course, with immediate and future advantage; and in other cases some temporary sacrifice, involved in the adaptation of standard apparatus to requirements, may be shown to be much more than offset by the advantages accruing therefrom. In any event, nothing can be lost and much may be gained by close contact and hearty co-operation between the buyer and the manufacturer. The interests of the two are in no sense antagonistic; in a large sense they are identical.

Standardization has been represented in this discussion as both a voluntary movement and an economic necessity. Regarded as a movement, its purpose may be said to be to reduce the ratio of cost to results secured; it is therefore in complete harmony with the present tendencies throughout the industrial world. It means neither retrogression nor stagnation; on the contrary, it implies progress—progress without unnecessary expense. Because an art is advanced with duplication of effort it scarcely follows that it cannot be advanced with concentration of effort. It seems logical to assume that the greater the concentration of effort, on correct and approved lines, the more rapid progress is likely to be. Needless expenditure of energy is as wasteful in industry as war is in a nation.

GREAT ELECTRIC-POWER INSTALLATIONS OF ITALY.

By Enrico Bignami.

Our readers will recall Signor Bignami's article in our August issue describing the great 15,000-horse-power plant at Paderno d'Adda. This account of a second and larger hydro-electric installation in Lombardy will serve to show yet more clearly the wonderful industrial development which northern Italy is undergoing through the co-operative efforts of the civil, the mechanical, and the electrical engineer.—THE EDITORS.



THE water-power and electric installation at Vizzola-Ticino, Lombardy, which was commenced in 1897 and finished in less than three years, is now in full operation. Its ownership is vested in the Società Lombarda per Distribuzione di Energia Elettrica, a company having its offices in Milan and incorporated with a capital of 10,000,000 francs especially for this undertaking, under the initiative of a great foreign concern, the Continental Gesellschaft für Elektrische Unternehmungen, of Nürnberg.

At present 19,000 horse-power is developed (later there will be a development of 24,000) from the Tessin river between its source in Lake Maggiore and its debouchement into the River Po, a reach along which it feeds the marvelous network of canals, in great part a heritage of past generations, that forms the main source of the agricultural wealth of the region surrounding Milan, Novara and Pavia.

The Water-Power Installation. Taking from the forebay of the Villoresi Canal (Figure 1) 55 cubic metres of water per second of the 65 of outflow from the Naviglio Grande (which are two of the most important canals of the network) admitting this water by regulating gates into a navigable canal built near and parallel with the Villoresi canal, and conducting it to a point below the village of Vizzola, there

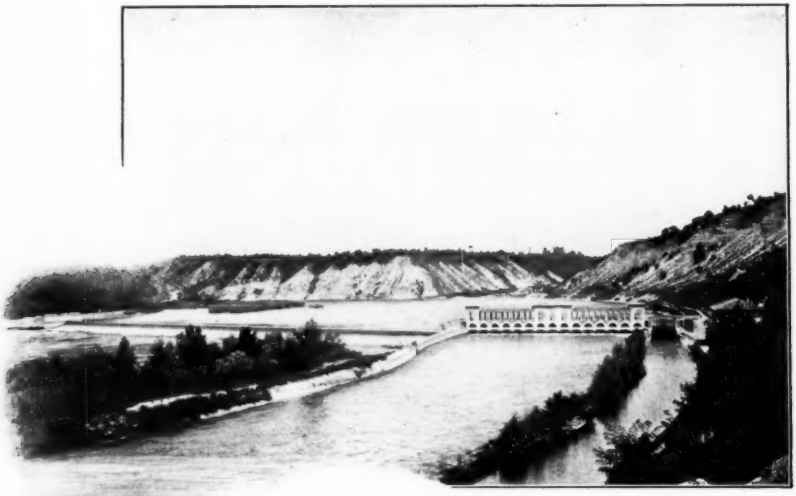


FIG. 1. THE GREAT BASIN AND HEAD-GATES OF THE VILLORESI CANAL.

returning it to the Tessin river and utilising a fall of 28 metres (92 feet)—this is how the hydraulic part of the project was accomplished by the Società Italiana per le Condotte d'Acqua, a concern with offices at Rome. The general plan of the water-power development is shown in Figure 2. The normal output is based on a flow of 55 cubic metres per second (62 in floods) from a water level 165 metres above sea-level. This is taken into the new canal through a regulator having four controlling gates. The new canal has a gradient of 15 centimetres in 1,000 metres (9 inches to the mile) for 6 kilometres (3.72 miles) to the opening of the great Castelnovate cut (Figure 3, page 188). At this point it divides into two branches, of which one is exclusively for navigation, with a small flow of 3 cubic metres per second, sufficing for boat service (Figures 4 and 5), and going directly to the Tessin; the other branch turns to the left and, passing over a valley by a fine aqueduct (Figures 6 and 7) 200 metres (656 feet) long, delivers to the forebay for the turbines about 53 cubic metres per second of water available for motive power.

From the forebay the water descends in twelve separate steel penstocks, open to view, to the turbines. From these it is discharged by separate tail races into a collecting canal which, a short distance below,

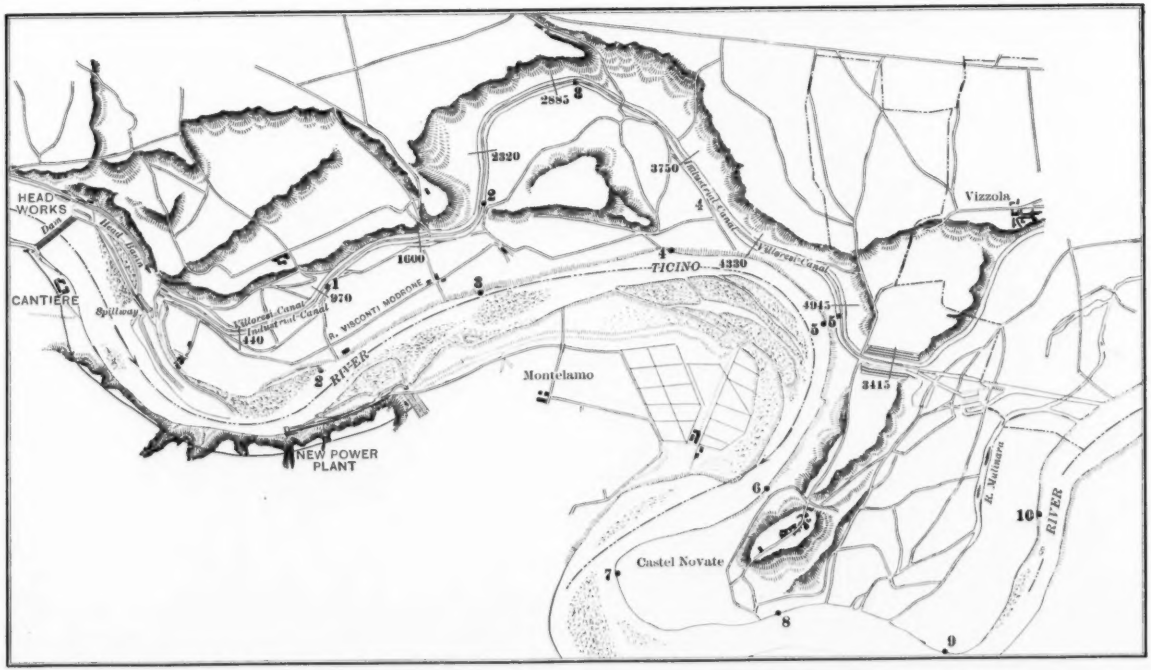


FIG 2. GENERAL PLAN OF THE CANAL AND ITS SURROUNDINGS.

unites with the navigation canal and flows out into the lower level of the river. The forebay is also provided with discharge openings and a large waste weir of 90 metres (295 feet) width communicating with a terraced outlet to the lower level of the navigation canal, thus carrying off the surplus water to the river below.

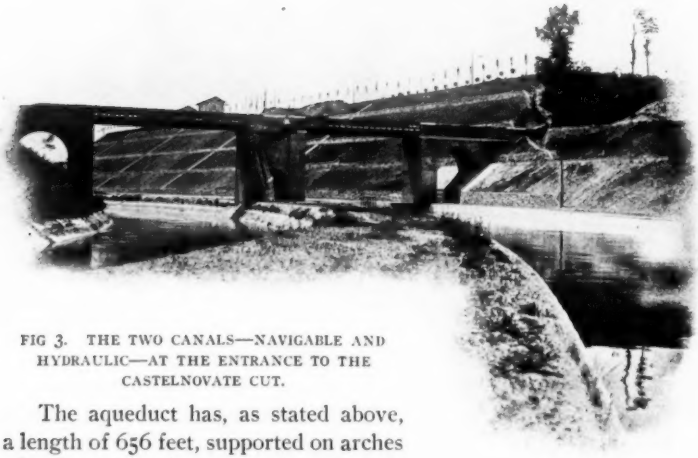


FIG 3. THE TWO CANALS—NAVIGABLE AND HYDRAULIC—AT THE ENTRANCE TO THE CASTELNOVATE CUT.

The aqueduct has, as stated above, a length of 656 feet, supported on arches of 4.8 metres (15.74 feet) span and 33½ inches thickness at the keystone, of concrete construction, resting upon heavy pile foundations of various depths, in solid earth. The normal depth of the water in it is 3.5 metres (11.4 feet) with its mean surface 10 metres (32.8 feet) above the ground level, and a velocity of flow of 3 metres (9.8 feet) per second. At the end of the aqueduct is the forebay, an enlargement necessary to reduce the velocity of the water and permit it to flow into the turbines without undue loss of head. Its construction is similar to that of the aqueduct. In the right-hand wall twelve circular openings, protected by a large grill and furnished with vertical-lift gates, having electric and hand control, lead to the twelve penstocks (Figures 8 and 9). On the left-hand wall, near the lower end of the basin and near the middle are three discharge gates, and at the upper part is a great waste weir 90 metres (295 feet) wide, which permits the surplus water

to flow over without inconvenience even in case of the sudden closing of all turbine gates. At the base of this left-hand wall of the basin is a reservoir floored with cencrete one metre thick and protected by a layer of water of the same thickness, which receives the surplus water of the forebay and the outflow of the terraced outlet (of masonry) which has a descent of about 20 metres (65.6 feet). These waters then flow into the low level of the navigation canal and thence return to the river.

Of all the ingenious works of this installation the aqueduct and the forebay in which it ends are certainly the points of greatest interest. Considering the amount of water which it carries this is one of the largest structures of its kind ever built. Questions concerning its strength and the impermeability of its walls and, above all, of the effects of unequal expansions and contractions in this immense block of concrete a thousand feet in length, were the subject of careful and prolonged study and research.

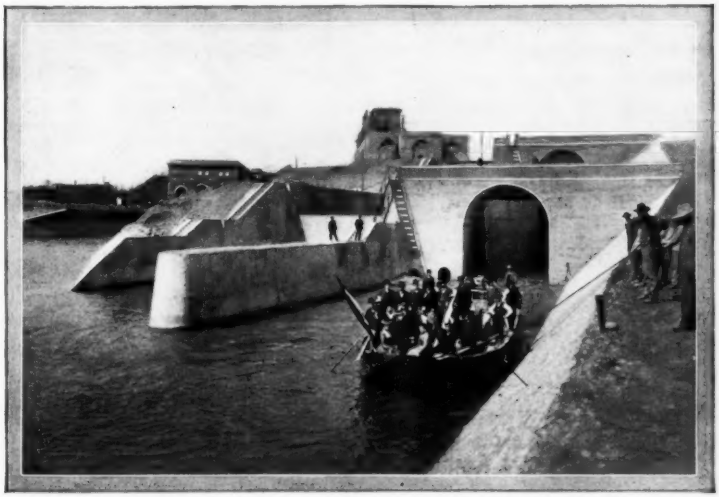


FIG. 4. THE NAVIGABLE CANAL AT ITS TERMINUS NEAR THE POWER PLANT.

Ordinary concrete, even in masses of great thickness and when made with mortar rich in cement, is always permeable to water. Only a tight, smooth and continuous lining is able to protect it. But this is a protection which is immediately spoiled when, either on account of the unequal disposition of the elements of construction or their displacement following expansions and contractions, cracks, even of the

smallest, are formed. These cracks or actual discontinuities are inevitable in this mass of about 25,000 cubic metres of concrete, unevenly distributed over a length of about a thousand feet and also unequally exposed to temperature variations. It became necessary, then, to guard against their consequences. The measure adopted (see the sections of the aqueduct, Figures 10 and 11) was to make a double wall and bottom for the aqueduct and forebay with three superposed layers of tarred felt, forming thus a practically impermeable partition in the interior of the mass and one which, even if subjected to great compression or extension, would give considerably without losing its continuity. This partition, much less rigid and much more perfectly watertight than the concrete, prevents any evil effects of cracks in the latter or of infiltration of water.

Such are the salient features of the Vizzola Ticino installation. Its importance may be judged, better than from any amplified description, from the following figures of its more important features:

Excavation	1,100,000	cubic metres
Masonry (90 per cent. concrete, 10 per cent. bricks, rubble, etc.)	90,000	cubic metres
Surfacing (linings, pavements, flooring, etc.)	50,000	square metres
Days of work of excavators, masons, etc.	650,000	

FIG. 5. THE VILLORESI HYDRAULIC CANAL AND THE NAVIGABLE CANAL IN THE GREAT CUTTING AT CASTELNOVATE.

FIG. 6. THE AQUEDUCT BRIDGE AND THE GREAT WEIR, 80 METRES LONG, OF THE HEAD BASIN.

The regulation of Lake Maggiore to serve as a reservoir, by means of the construction of a movable dam, will assure to the power canal at Vizzola a constant flow at low water of 65 cubic metres per second, corresponding to 24,000 horse power. Looking forward to this rate of working all of the works have been constructed susceptible of enlargement to these dimensions.

The Water-Power-Electric Installation. From the forebay at the foot of the aqueduct the water is led in twelve steel penstocks to the turbines. Here commences the electrical installation which comprises the following elements:

The power house for the production of electrical energy, commonly called the central station.

The electrical transmission line.

The receiving installations.

The central station produces its electrical energy under the form of high-tension three-phase alternating current. The generating units are ten in number, each consisting of a 2,000-horse-power turbine wheel direct-coupled to a three-phase generator of corresponding size (Figure 12, page 196). Since the territory in which the most of the power generated at Vizzola is consumed is situated from 15 to 18 kilometres from the station, it was decided to adopt a primary

FIG. 7. VIEW OF THE AQUEDUCT BRIDGE, THE HEAD BASIN, AND POWER PLANT FROM THE RIGHT BANK ABOVE.

tension of 11,000 volts, generated directly by the dynamos. In addition to the power-generating machines two smaller direct-current units have been installed to furnish exciting current for the large dynamos and current for the accessory services of the central station, such as power for the repair shop, the electric crane, the movement of the control gates, and for lighting. These two units each consist of a 220-horse-power turbine direct-coupled to a continuous-current dynamo (Figure 13). The total capacity of the turbines is thus 20,440 horse

FIG. 8. CENTRAL HYDRO-ELECTRIC STATION AT VIZZOLA.
Head basin, gates, and penstocks on the right; power house below on the left.

power, of which 2,000 horse power is held as a reserve. The station, as well as all the auxiliary distributing and transmitting installations, was constructed upon the designs of Signor A. Scotti, engineer and director of the Società Lombarda, which owns and operates the plant.

The Turbine Wheels. Seven 2,000-horse-power wheels were put in for the first installation, of which five were built by Riva Monneret & Co., of Milan, and two by J. M. Voith, of Heidenheim, Germany. All the wheels are of a similar type, having horizontal shafts with two runners and two distributors of the twin type, introducing the water radially from the outside. Discharge is by means of draught-tubes and the head varies from 28 metres (92 feet) at time of low water to 24

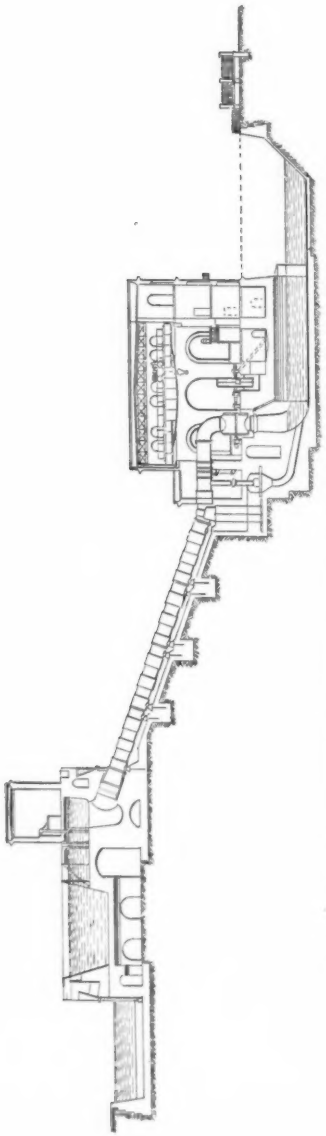


FIG. 9. GENERAL LONGITUDINAL SECTION OF FOREBAY, PENSTOCKS, AND HYDRO-ELECTRIC STATION.

metres (78.7 feet) during freshets. The guides carry steel baffle plates and the gates are of the revolving balanced type. The wheels run at 187 revolutions per minute and the shafts end in flanges for rigid coupling to the dynamos. Automatic regulation is obtained by means of auxiliary apparatus on the Riva wheels and by mechanical auxiliaries on the Voith wheels.

All of the dynamos and other electrical apparatus were built by the Elektricitäts Aktien Gesellschaft, formerly Schuckert & Co., of Nürnberg. The main generators are of the three-phase type having stationary armatures and revolving fields excited by a single coil. Their normal capacity is 1,650 kilowatts at 11,000 volts and 50 cycles per second. The two exciters are ordinary direct-current machines, rated at 145 kilowatts at 110 volts.

All the accessory apparatus are assembled on two switchboards, in rooms one above the other on different floors of a building designed for them. The control apparatus for the dynamos are on the lower board and those for the lines on the upper board. Lightning arresters are assembled in a third room, entirely separated from the others, outside of the dynamo building at the end of the transmission line.

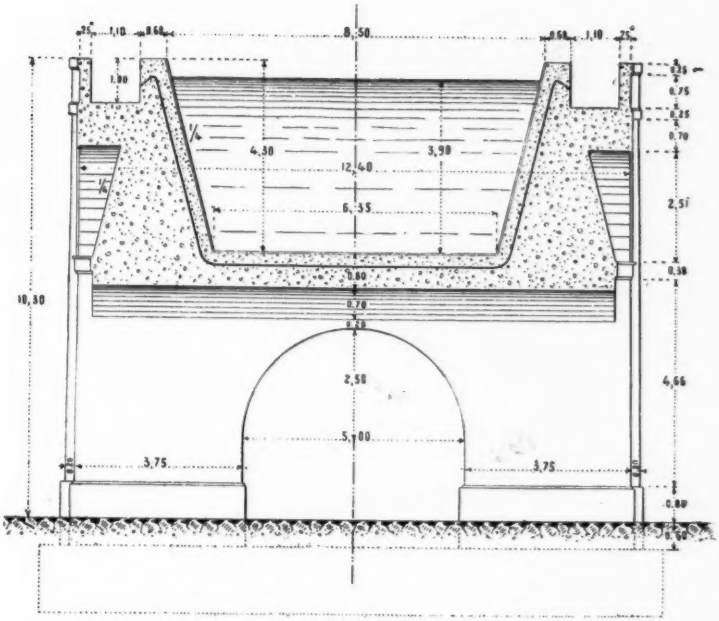


FIG. 10. SECTION OF THE AQUEDUCT. DIMENSIONS ARE IN METRES.

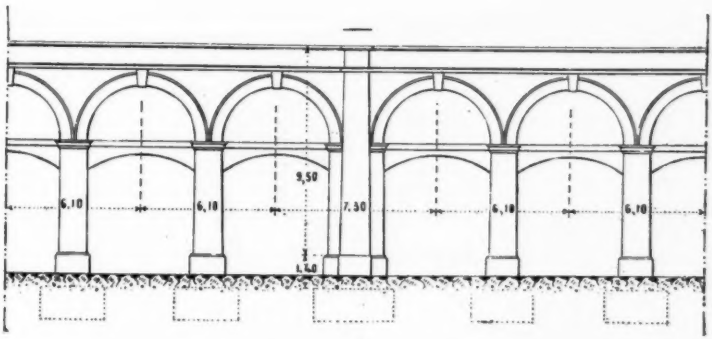


FIG. 11. ELEVATION OF THE AQUEDUCT. DIMENSIONS ARE IN METRES.

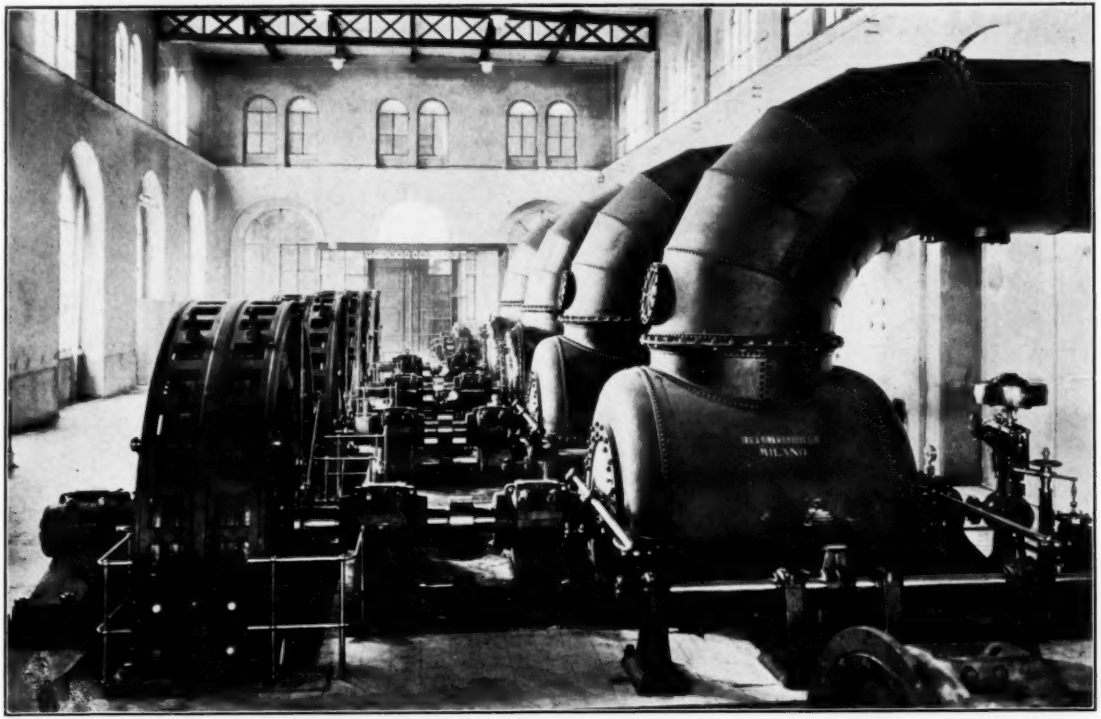


FIG. 12. THE POWER HOUSE. THE TURBINES, OF 2,000 HORSE POWER EACH, ARE COUPLED TO SHUCKERT ALTERNATORS OF 1,650 KILOWATTS AT 11,000 VOLTS.

Transmission Lines. Milan is about 40 kilometres (25 miles) from this power development, which is in one of the richest industrial regions of Italy, comprising the manufacturing centres of Gallarate Busto Arsizio, Legnano, respectively 10, 15, and 18 kilometres from Vizzola, and Valle Olona, in which the single industry of cotton manufacture (which prospers there on a solid basis and from ancient times) employs more than 10,000 horse power generated by steam. Among the manufactories taking power from the Vizzola plant may be mentioned Banfi & Co., cotton weavers, of Legnano, (Figure 16 and 17), using about 1,800 kilowatts and presenting several ingenious adapta-

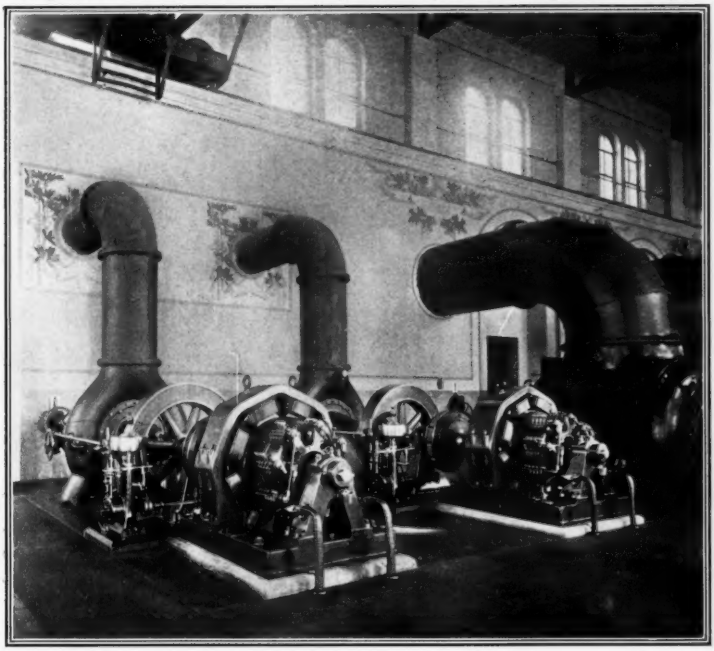


FIG. 13. CONTINUOUS-CURRENT EXCITER DYNAMOS OF 145 KILOWATTS AT 110 VOLTS, COUPLED TO 220-HORSE-POWER TURBINES.

tions of electricity to a manufacturing establishment hitherto entirely steam-driven. Others are the Cotonificio Cantoni, at Castellanza and Legnano, using 800 kilowatts; Carlo Ottolini, at Busto, taking 600 kilowatts; and the spinning establishments of A. A. Ponti at Solbiate; Luigi Candiani at La Garottola, and Somaini & Co., at Lanagro with 400 kilowatts each. In Figure 14 are shown the transmission lines.

FIG. 14. TRANSMISSION LINE CROSSING THE MOORS OF GALLARATE.

From considerations of safety and ease in handling, each centre of consumption has its own transmission line from the central station, which can be made entirely independent of the others. Lighting, in the principal centres of Gallarate, Busto Arsizio, and Legnano, is carried on over circuits independent of the power-transmission wires. All of the 11,000-volt primary lines are overhead and are carried on poles partly of wood and partly of iron, with triple-bell porcelain insulators The poles, lines, and insulators are shown in the illustration above.

Receiving Installations. In the principal centres of consumption requiring a widespread distribution of energy among numerous small consumers, as at Gallarate, Busto Arsizio, Legnano, and Saronno, the primary lines feed a transformer station (transformers of a normal type, of 200 kilowatts), from which a secondary distribution at 3,600 volts is made. The customers receive current either at this pressure

FIG. 15. TRANSPORTING DYNAMOS ACROSS THE GALLARATE MOORS.

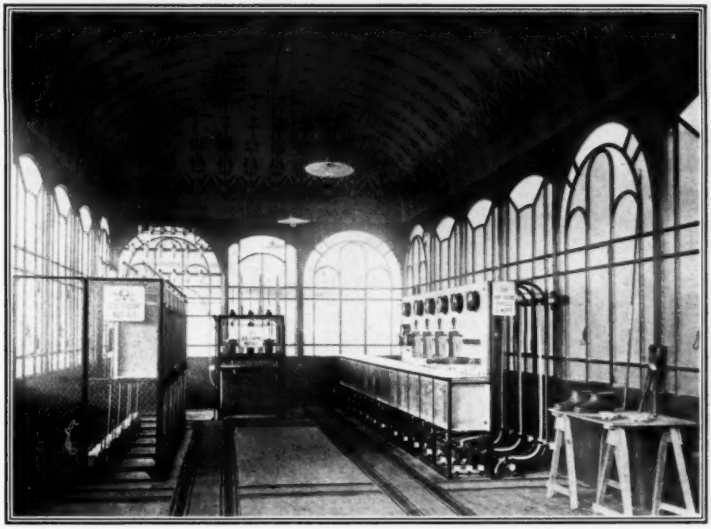


FIG. 16. SWITCHBOARD ROOM AND MEASURING APPARATUS AT THE RECEIVING STATION OF THE WORKS OF FRUA BANFI & CO., LEGNANO. 2,500 HORSE POWER.

or, after a second transformation, at 125 volts (Figure 19). The transformers were furnished by Brown, Boveri & Co., of Baden, Ganz & Co., of Budapest, and Schuckert & Co., of Nürnberg. The large consumers, such as the large weaving and spinning establishments at Valle Olona and those near by, have their own transformer installations on the 11,000-volt primary, furnishing them with 500-volt current. The power company's installation proper terminates at the secondary terminals of these transformers.

FIG. 17. RECEIVING STATION OF FRUA BANFI & CO., LEGNANO.
Five transformers of 500 kilowatts each reducing 1,000-volt current to 500 volts.

The contracts for power already closed, which absorb all the output of the first installation, are based on the forfeit principle; that is, on a given price per kilowatt per year and for all the kilowatts bought by the consumer. The price varies between a maximum of 400 lire (£16 or $80) for installations under 5 kilowatts, and a minimum of 160 lire (£6 8s. or $32) for consumers using over 700 kilowatts for periods of 12 hours. This "flat rate" method, possible with installations of this character, has resulted in facilitating the sale of power, simplifying the installations, and reducing the costs of opera-

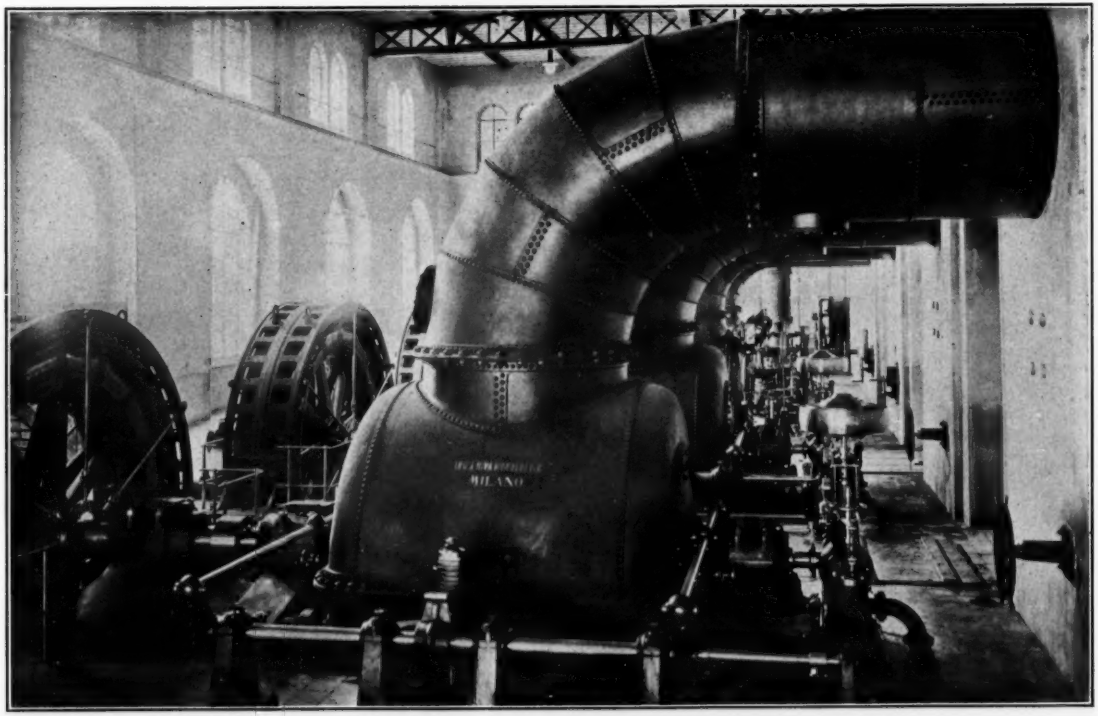


FIG. 18. THE 2,000-HORSE-POWER TURBINES BUILT BY RIVA, MONNERET & CO., OF MILAN.

FIG. 19. SUBSTATION OF THE VIZZOLA-TICINO INSTALLATION, FOR TRANSFORMING FROM 11,000 VOLTS TO 3,600.

tion. It has contributed largely to the good results attained in 1900 and exhibited in the statement just made to the general meeting of the company, in which the administrative council was authorized to put out more than 100,000 lire of new shares.

The Vizzola-Ticino installation is today, in power output, the largest of its kind in Europe and the most important also of a series of others that will soon utilise the residual powers of the river Tessin between Sesto-Calende and the Po—powers estimated at 20,000 horsepower and which will be employed also for electric traction.

THE MINING DEVELOPMENT OF GILPIN COUNTY, COLORADO.

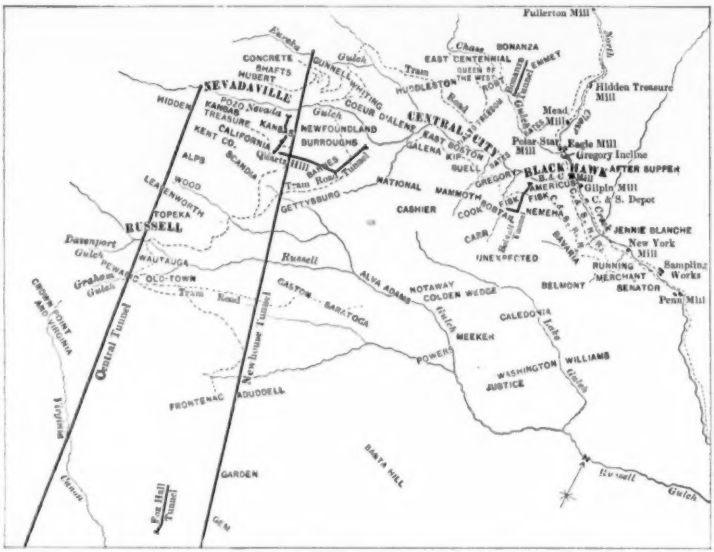
By Thomas Tonge.

The characteristics of modern mining, which have put it upon a sound basis commanding the confidence of any required amount of capital, are rigorous and thorough engineering methods of examination, economical working by the aid of mechanical appliances, and minimising of general cost burdens by "intensified production." These three tendencies of modern practice are well exemplified in the region described in this article by Mr. Tonge.—THE EDITORS.

GILPIN COUNTY, while the very smallest in area, is one of the important mining counties of Colorado and is specially interesting for the following reasons. (1) It was the scene of the first lode mining in Colorado, namely, in May, 1859, since which time the county has produced over $100,000,000 worth of mineral, mostly gold, and principally from a small belt of territory about four miles long by two-and-a-half miles wide, of which Central City is approximately the centre. In such limited area there are ten mines which have passed the $1,000,000 mark in production, and thirty-six of the leading mines have produced $60,000,000. (2) Placer mining was conducted in Gilpin County contemporaneously with its first employment in Colorado. (3) The first successfully operated smelting plant in America was established at Black Hawk in this county. (4) The infinite number of the mineral-bearing fissure veins and the lateral and vertical continuity of some are phenomenal. (5) The district is an interesting illustration of the evolution of mining and metallurgy and the steady reduction of operating expenses. (6) After forty-two years of practically continuous operation, the local mining industry, with the improved mining and metallurgical methods now in vogue, has obviously a future much greater than its past.

On 6th May, 1859, as stated in Fossett's "Colorado" (1876), John Gregory, a prospector, climbed the hill into what is still known as

Gregory Gulch (midway between the present Central City and Black Hawk), scraped away the grass and leaves, filled his gold pan with dirt, and took it down to the stream. Upon panning (washing) it down, there was about four dollars' worth of gold in it. This was followed by a stampede to the Gregory Diggings, as they were afterwards called. Gregory employed five men from the new arrivals and by means of a sluice took out $972 in one week. Other rich strikes were made almost daily and large amounts of gold were taken out in a short time. The Bates, Bobtail, Mammoth, Gunnell, Burroughs, Illinois and hundreds of other lodes were found and thousands of claims were taken up. As the summer of 1859 advanced, the wealth of the gold veins and gulches of what is now Gilpin County became more and more apparent. Over 15,000 men were congregated in Gregory, Russell, and tributary gulches, and many of them were accumulating wealth rapidly; but everything valuable was soon pre-empted and large numbers were forced to hunt their fortunes elsewhere.



MAP OF THE BLACK HAWK REGION, GILPIN COUNTY. BY GEO. W. SCHNEIDER, E. M.

By the laws adopted by the miners of Gregory District, it was enacted:—(1) That no miner should hold more than one claim, except by purchase or discovery. (2) That each miner should be entitled to

one "mountain claim" 100 feet long by 50 feet wide, one "gulch claim," 100 feet up and down the river or gulch and extending from bank to bank, and one "creek claim" for the purpose of washing. Time has increasingly proved that the "mountain claims" were none too large for surface work and entirely too small for deep mining, and the inadequate size of these original claims has been a serious hindrance in the

GREGORY GULCH, SHOWING EARLY SURFACE WORKINGS.
The Fiske mine is on the extreme left; then come in order the Cook, the Carr (on the ridge), and the Ontario Colorado. The small black cross in the left foreground marks the spot where gold was first discovered.

subsequent development of the district. Subsequent to 1872, by local modification of the United States statutes, new claims were allowed to be 150 feet wide by 1,500 feet long, without, however, disturbing the status of the older smaller claims.

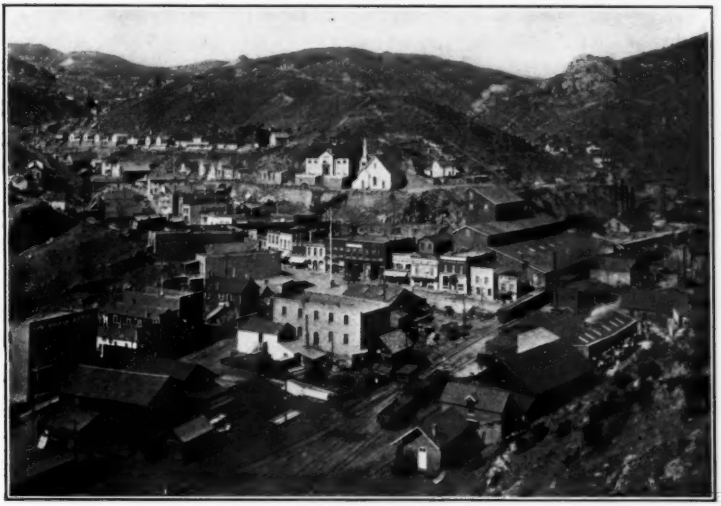
The surface dirt and "slide" from the veins were at first washed for gold by means of small iron hand-pans and by rockers and then by sluices. As an instance, Spring Gulch in 1860 yielded two ounces of gold to the man per day, or about $35. Arrastras were subsequently utilized in grinding up the dirt and surface quartz, and answered very well until the contents of the veins became so hard as to require stamps. An arrastra, run by ox-power, was started up in June, 1859, and a water-power arrastra in the following month, with a daily capacity of twelve tons of comparatively soft surface ore. Other arrastras followed. During the remainder of 1859 several small, prim-

itive stamp-mills were established locally, and in 1860 other stamp mills arrived by the score. At first, they were rude, imperfect affairs and destitute of copper-plated tables. After the surface quartz was exhausted and the miners had sunk down in the veins to the iron pyrites, they saved but little gold and the mill men in 1861-2-3-4 were often unable to obtain the gold even on copper-plated tables, owing to their inexperience. From 1864 to 1867 followed an era of "process mania," which was still worse than the incapacity of the pioneer mill men.

In 1867 there was erected, at Black Hawk, a smelting plant of twelve-tons daily capacity, consisting of one reverberatory and one calcining furnace, with the requisite machinery for crushing, pulverizing, etc. It commenced operations in January, 1868, and proved a success. The result was that the miners, finding a ready cash market for their ore, began to operate their abandoned claims and the local mining industry commenced a career which has ever since been maintained. As illustrating the local conditions at the time of the commencement of operations by this pioneer smelter, it may be stated that every single fire-brick used in its construction cost $1.00, having to be brought by wagons about 600 miles from the nearest point on Missouri River and to that point by railroad from St. Louis; the iron cost 22 cents per pound; the pay of skilled labor was $8 per day, and of common labor, $4 per day; and the charge for smelting ranged from $20 to $45 per ton. There was no railroad nearer than the Missouri River, about 600 miles away; wagon transportation was high, as also were all the necessaries of life. Moreover, the "matte," the product of the plant, in the absence of any local means of separating or refining, had to be hauled to the Missouri River in wagons, thence by railroad to New York, and thence to Swansea, Wales, where it was separated and the gold, silver and copper refined.

The impetus so given to the local mining industry by the establishment of the smelter at Black Hawk also beneficially affected the local stamp-milling industry, treating the ore too low-grade to send to the smelter. In 1875 there were twenty-two mills in the county, aggregating four hundred and forty stamps. In October, 1876, the number of stamps dropping had increased to seven hundred and seventy. In 1901, on the North Fork of Clear Creek, in the vicinity of Black Hawk, there are twelve stamp mills, comprising nearly six hundred

(NOTE.—This smelting plant was moved from Black Hawk to Argo, near Denver, in 1878 and for many years past has had a daily capacity of 200 tons, and its own refinery producing gold and silver bullion and pig copper.)



GENERAL VIEW OF BLACK HAWK.

The Boston and Colorado 80-stamp mill is directly in the right foreground.

stamps, of which about four hundred stamps are "slow-drop," averaging from twenty-eight to thirty-two drops per minute, with a crushing capacity of from $^1/_2$ to $^2/_3$ of a ton of ore per stamp, per day of twenty-four hours. The remaining two hundred stamps are "rapid drop" ranging from sixty-five to ninety drops per minute, with a crushing capacity of from $1^1/_2$ to 3 tons of ore per stamp, per day of twenty-four hours. There are various other similar mills in other parts of the country.

In 1901 there are about one hundred properties, large and small, more or less regularly shipping ore. There are in addition quite a number of dormant properties, merely awaiting new enterprise, new capital, consolidation of adjoining claims, and modern mining methods, to become ore-producing, dividend-paying mines. Apart from the comparatively large amount of Colorado capital invested in the mines of the district, many of the properties represent capital from New England, New York, Philadelphia, Pittsburg, Chicago, Detroit, St. Louis, St. Joseph, and other American financial centres, and also from Canada, England, Belgium, etc. The great majority of the mines are owned, not by ordinary mining stock companies, but by private companies, syndicates, or private individuals. No Gilpin County mine is listed on any stock exchange.

The last biennial report of the Colorado State commissioner of mines shows that in the mines and mills of Gilpin County, in 1900, there were 3,124 men employed, as against 3,017 in 1899, and for 1900 the State commissioner estimates the mineral output as $1,967,550, of which $1,655,501 was gold and the rest silver, lead, and copper. It may here be observed that there are no better miners than those of Gilpin County anywhere in Colorado or the world. There is a considerable number of Cornishmen and Welshmen. Speaking generally, the Gilpin County miner takes care that his children are educated and is a supporter of churches rather than of saloons. The local standard wages for miners are from $2.50 to $3 per day for nine-hours work. There has never been a miners' strike in the county, and the two national banks at Central City have $1,000,000 on deposit, largely representing the accumulated savings of the miners.

The infinite number of the local fissure veins and the continuity laterally and vertically of some of them calls for special mention. Quartz, Gregory, Bobtail, Gunnell and other hills are one vast net-work of veins, with here and there huge deposits of ore—some of them of great value. There are a number of main veins with an infinity of comparatively minor parallel, diagonal, and cross veins.

The Gregory, the first gold-bearing lode found in Colorado, named after its discoverer in 1859—John Gregory—has been one of the most productive lodes in Colorado and one of the most widely known, its past record production being upwards of $15,000,000. It has been operated, more or less, for at least a mile in length, the greatest depth hitherto attained being about 1,000 feet. The surface dirt was washed in the gulch by sluices and was exceedingly rich. The Bobtail vein, with a past record of production of upwards of $8,000,000, begins on Bobtail Hill at Black Hawk, and running west is operated in a series of properties to an aggregate length of one mile. It is now believed by some that it is a continuation of this vein that is found on the opposite side of Spring Gulch on Quartz Hill, in the California and other properties, for a further distance of one and a half miles, thus making, if this theory is correct, a total length of two and a half miles. The Fisk vein, so far as known, begins near Black Hawk and is operated, in a consecutive series of properties, for over half a mile. The Gunnell vein, with a past record production of several million dollars, has been opened and is now worked for the distance of a mile in length. The Frontenac vein extends through a succession of properties and over the line into Clear Creek County, having been opened up and operated for a total length of over one and one-half miles. Several

other veins of great length could be mentioned, those referred to specifically being merely typical of the district.

As to the continuity vertically, experience has shown that in many cases surface veins unite with depth and jointly form a large vein which continues with great depth. The California shaft is 2,250 feet deep, while in the limited mineral belt surrounding Central City there are several shafts over 1,200 feet deep and perhaps twenty shafts ranging from 700 feet to 1,200 feet, all still in ore. In the same belt, near the dividing line between Gilpin and Clear Creek counties, the New-

NEVADAVILLE. HIDDEN TREASURE MINE ON THE LEFT, CALIFORNIA MINE (WITH A SHAFT 2,250 FEET DEEP) ON THE RIGHT.

house Tunnel, 15 feet by 12 feet in size, recently intersected the Gem vein at 2,000 feet below the surface, following the dip of the vein, and 1,400 feet vertical depth. In merely driving the tunnel through this Gem vein, at right angles, 13 tons of smelting ore and 116 tons of mill dirt were taken out, which netted $1,150. The streak of smelting ore and mill dirt at the point of intersection is nine feet wide, the vein itself being considerably wider.

The State commissioner of mines, in one of his annual reports, says of Gilpin County:—

"The veins are true fissure veins and vary in width from two to twenty feet. Associated with the brecciated and impregnated gangue, regular streaks of 'solid ore' are not uncommon, usually carrying higher values. These are separated and shipped as 'smelting ore.' The remaining part is mined and shipped as 'mill dirt.' The ores are iron and copper pyrites, galena, and zinc blende, with ordinary associated minerals, the principal values being in gold. The gold and silver contents vary in value from a few dollars to several hundred dollars per ton."

He also says:—

"Many customs inaugurated with the establishment of this district are still in vogue. For example, all mill ore is estimated by the 'cord.' A 'cord' in this section contains between 7 and 8 tons of ore by weight, and is usually estimated at 8 tons. The contract system in mining is quite common. Originally all work was let by the 'fathom,' i. e., 6 feet; but of late shaft and drift contracts are let by the foot (12 inches) and ore stoping by the fathom, i. e., 6 feet along the vein by 6 feet high. Smelting ore, on the other hand, is transported and sold on the ton basis of 2,000 pounds. To the uninitiated, the combination is somewhat confusing, especially when a mine manager speaks of shipping two-ounce gold ore and milling two-ounce gold ore; the former meaning two ounces per ton, and the latter two ounces per cord or eight tons. Even more is implied in regard to milling ore, viz., two ounces per cord is understood to mean the amount of gold saved by amalgamation, does not include the value of concentrates saved or contained, and, therefore, has no reference to the gross value of contents."

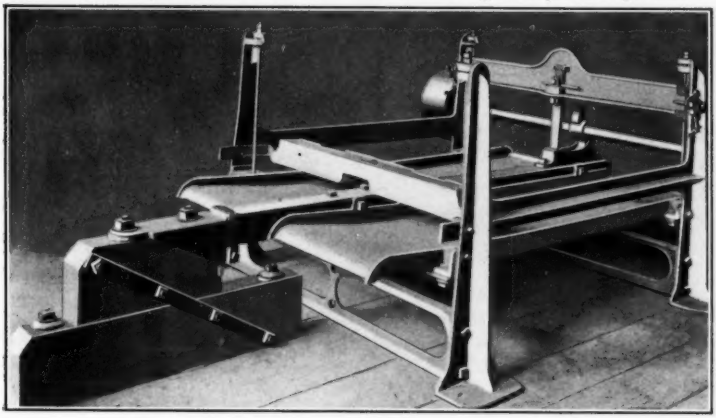
Speaking generally, there are three classes of local ore, viz:—(1), smelting; (2), milling; and (3), concentrating. Bobtail Hill, Gunnell Hill, Quartz Hill and other hills and all of the Perigo district produce ore, the higher grade of which, i. e., above $18 per ton in value, goes to the smelters and the lower grade to the stamp-amalgamation mills. Of the Russell Gulch district ore, the higher grade, i. e., above $15 per ton in value, goes to the smelters and the lower grade is best treated by concentration.

There have been numerous changes for the better in local mining and metallurgy within the last twenty years. In that period the "Gilpin County concentrating table," a local invention, has superseded the old "hand buddle" introduced from Cornwall, for the concentration of the tailings from the stamp-amalgamation process. Twenty years ago there was no market whatever for the concentrates from the tailings, but for a number of years past such concentrates have been in increasing demand by the smelters. The present rate of yield is one ton of concentrates, averaging $10 per ton in value, to eight tons of crude ore. Thirty years ago the stamp-mill charge, with very imperfect saving of values, was $5 per ton; twenty years ago, with improved saving of values, it was $2.50 per ton; to-day the charge is

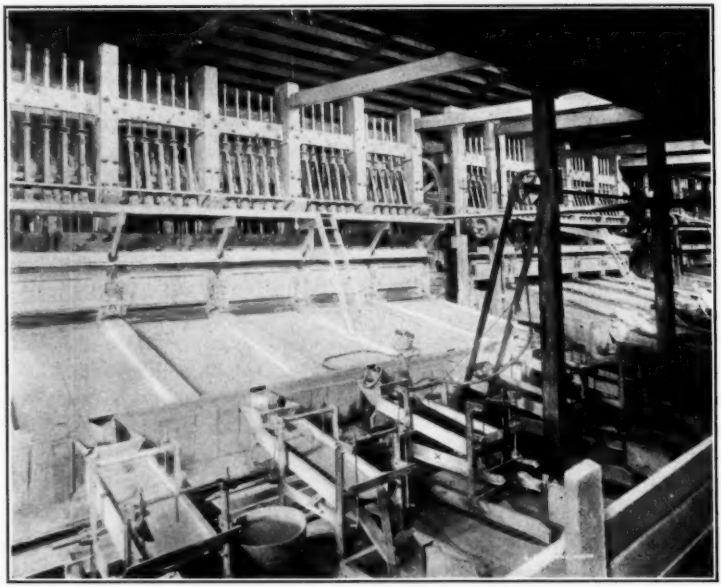
$1.25 per ton, the saving of values being about 80 per cent., viz., 70 per cent. on the plates and 10 per cent. on the concentrating tables. Thirty years ago the smelting charge was $35 per ton and upwards; twenty years ago it had been reduced to $20 per ton; to-day it ranges from $7 to $12 per ton, on smelting ore, according to the character of the ore, and $2 per ton on concentrates.

Railroad and wagon freight rates have been reduced at least one-third within the last six or seven years and more than 50 per cent. in the last twenty years. The Gilpin County Tramway, with twenty miles of trackage, including the main line and spurs, connects many of the shipping mines with the stamp mills on the North Fork of Clear Creek and also with the Colorado & Southern Railroad, so that mill dirt goes economically from the mine shaft to the mill, and smelting ore from the mine shaft to the smelters at Denver and Pueblo. The Colorado & Southern Railroad some years ago commenced and has since continued a freight rate of 50 cents per ton on low-grade concentrating ore from Black Hawk to the mills near Idaho Springs, Clear Creek County, and from 150 to 300 tons per day of such ore goes either by railroad, or direct by wagon, from Gilpin county to such Clear Creek mills where the water supply is ample.

The metallurgy of Gilpin County has by no means attained finality. For the typical Gilpin County mill dirt the mill men (who virtually monopolize all the local water supply) claim that nothing superior to the ordinary Gilpin County stamp mill and Gilpin County concentrating table has yet been devised, notwithstanding many attempts. On



A GILPIN COUNTY BUMPING TABLE.



TYPICAL STAMP MILL, WITH GILPIN COUNTY BUMPING TABLES.

the other hand, some at least of the mine operators claim that the local mill men are ultra-conservative and comparatively unprogressive, and that some of the newer concentrating tables like the Wilfley, Cammett, and other modern value-saving devices could be locally utilized with advantage. This is met by the question whether the extra saving of values would justify the additional expense. The fact remains that the mill men themselves do not claim an average saving of more than 80 per cent. of the values, though the best local mills, kept in first-class condition and operated by careful and experienced men, treating suitable ores, are said to save as high at 90 per cent. of the values. Other mills, needing repairs and operated in a careless manner, naturally save considerably below the average of values from the custom ores committed to their charge. Up to a few years ago, in consequence of imperfect methods, from 40 to 60 per cent. of the values of the ores locally treated went with the tailings into the creek. The future will certainly see the present average of 20 per cent. loss materially reduced.

The controversy of slow-drop versus rapid-drop also remains unsettled. The drop usual in Gilpin County is from twenty-eight to

thirty-two per minute, with high discharge from the mortar, the idea being to keep the pulp in the battery as long as possible, thereby obtaining comparatively complete amalgamation in the battery before the material reaches the plates. One effect of this, however, is to sacrifice the concentrates, as the product is slimed to such an extent that it is more difficult to catch the values on the concentrating tables. In the fast-drop of sixty-five drops and upwards per minute, with low discharge from the mortar, the capacity of the mortar is increased, and while the probabilities of saving by amalgamation are reduced, the saving on the concentrating tables is increased. It is claimed, however, that not only has the concentrate product been increased, but the saving on the plates has been maintained up to the percentage achieved by the slow-drop system. In the slow-drop method, the pulp would pass through a 150-mesh screen, although they only use a 40-mesh screen. In the rapid-drop method, the pulp would pass through less than a 100-mesh screen, although they also use a 40-mesh screen.

There are naturally gradations in the so-called free-milling sulphide ores of the district. For an ore in which from 70 to 80 per cent. of the values can be saved by amalgamation, the slow-drop system is said to be the best, while where not to exceed from 40 to 50 per cent. of the values can be saved on the plates, the fast-drop is said to be the best, as producing a greater percentage of concentrates and the values are saved on the cencentrating tables as well as on the plates.

As to the concentrating ores of the Russell Gulch section, there are immense quantities averaging from $8 to $9 per ton, which regularly concentrate from three to five tons of crude ore into one ton of concentrates, with small loss of value. Such concentrates are in increasing demand at the Denver and Pueblo smelters and will be in great demand at the pyritic smelter just completed at Golden on the line of the Colorado & Southern Railroad only twenty miles below Black Hawk. It is simply a question of a short time when the local output of this concentrating ore witnesses very material increase.

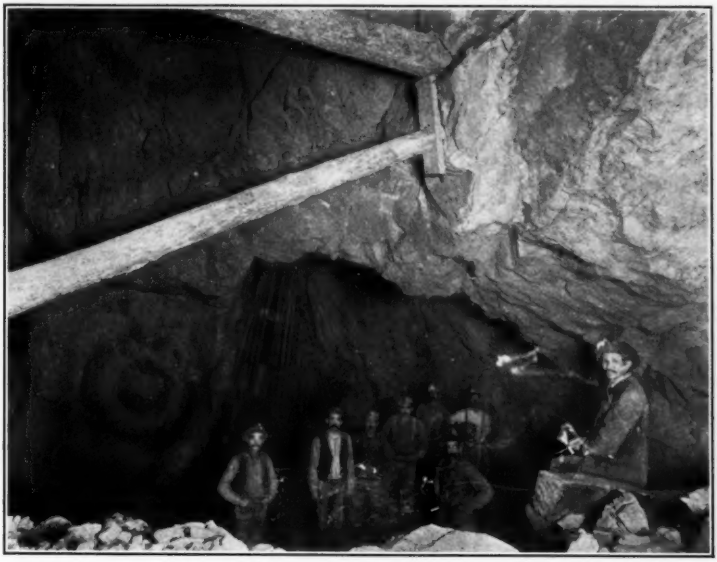
One especial need in Gilpin County is the consolidation of adjoining properties, covering continuations of the same veins, and the effective opening up of such consolidated properties on large scale, looking to the maximum tonnage output at minimum cost per ton. For some years past there has been a decided movement towards the consolidation of adjoining claims (individually too small to admit of operation on business principles) so as not only to adjust conflicting interests and thereby terminate or preclude litigation, but also to admit of the economical operation of the consolidated area through one or more

main shafts. Several instances of such consolidation and the advantages thereof are interesting, especially as they best illustrate local conditions.

The Cook-Gregory-Bobtail Consolidation on Gregory and Bobtail Hills now comprises over 10,000 feet, or practically two miles laterally, of the apexes of the historic Gregory, Bobtail, Mammoth, Fisk, Cook and other gold-bearing veins. Prior to such consolidation (the last portion of which was effected in the fall of 1900), the property consisted of eighteen different ownerships, representing a still prior condition of practically hundreds of ownerships. Such segregated properties had numerous more or less obsolete or antiquated shafts and no less than 25 miles of underground workings. It was simply impossible to operate the segregated properties to the best advantage. The past record production of the ground comprised in this consolidation, as shown in the books of the local banks and other authentic sources of information, is upwards of $17,000,000. In December, 1900, Mr. William A. Farish, M. E., the Nestor of his profession in Colorado and the west, after a careful personal examination, estimated the actual ore reserves in the consolidated property, above the present depth of the mines, ascertained from actual surveys and measurements, to be 1,706,793 tons and the additional or probable ore reserves, above the present depth of the mines, i. e., those portions of the veins the value and width of which had not then been determined by the levels, but of which there could be little doubt, to be 1,500,000 tons. Inasmuch as several of the larger veins very nearly come together at one point on the Cook mine, it was decided (prior to the final consolidation) to sink a large three-compartment perpendicular shaft at that point, from which all such veins could be exploited by simply crosscutting to the veins. The Cook shaft is now down 900 feet and will eventually be continued to a total depth of 2,000 feet. At each 100 feet levels will be run on all the different veins. At a depth of 357 feet below the collar, the shaft is intersected by the old Bobtail Tunnel driven many years ago. The ore from below the 357-foot level is hoisted on the cage to the tunnel level, where it is dumped into receiving bins, thence automatically loaded into cars and hauled by electric motor through the tunnel to the stamp mill a mile distant. The electric motor has a capacity of hauling 1,000 tons of ore every 24 hours, at a cost of about four cents per ton. A new mill of 320-tons daily capacity has been erected with eighty 1,000-pound stamps dropping ninety times per minute.

The modern development and equipment installed by the consoli-

dation mean the maximum production at the minimum cost per ton, and consequently the maximum profit per ton. While the larger proportion of the reserves consist of low-grade ore left by former operators, as out of the range of profitable mining and treatment by the then unduly costly methods, such ore reserves, under the new system, can be mined and treated at a total cost not exceeding $2.72 per ton, with



STOPE 26 FEET WIDE IN THE COOK MINE.

probability that it will be done for about $2 per ton, showing a net profit, at a cost of even $2.72 per ton, on the 1,700,000 tons actually in sight, of nearly $4,000,000, to say nothing of the additional probable ore reserves of 1,500,000 tons.

This consolidated property, however, is by no means a very low-grade proposition. During the past few years, out of 127,000 tons of ore mined and milled from one portion of the property, the value actually recovered from the ore averaged $8.80 per ton, at a cost, even under the then-existing conditions, not to exceed $5 per ton. Under the improved and more economical methods of operating, at say $2.50 per ton, the margin of profit is materially increased.

The future of this property can scarcely be anticipated. At the present time, the underground workings have attained a depth of nearly 1,000 feet at only two points half-a-mile apart. Having regard

to the before-mentioned ore bodies disclosed in the California shaft and Newhouse tunnel at a depth of 2,000 feet, the Cook-Gregory-Bobtail consolidation has below the 1,000 feet level, another 1,000 feet of virgin territory on all its two miles laterally of ore-bearing veins. Mr. Thomas Del Boca, M. E., Paris, France, estimates that with modern methods of mining and metallurgy, the additional 1,000 feet of depth on this consolidation will yield $50,000,000 of profit.

The Gunnell consolidation on Gunnell Hill now comprises 7,000 feet laterally of gold-bearing veins, including 2,350 feet laterally of the famous Gunnell vein. Prior to such consolidation, the property was held in lots of all sizes from 100 feet long and upwards, representing nearly twenty different ownerships and having several dozen shafts, the majority of which were more or less shallow and practically useless. Portions of the property had been the subject of costly litigation, extending over years, but which was finally judicially decided in favor of the immediate predecessors of the present owners. The property now included in the consolidation has a past record production since 1859 of over $6,000,000 and is still practically a virgin property. Under the new consolidation, a system of up-to-date developments, on uniform plan, was inaugurated, on which nearly $100,000 has already been expended, irrespective of current mine expenses. There are now three main working shafts. Included in the Consolidation are stamp-mills on North Clear Creek aggregating over one hundred stamps and a capacity of 4,000 tons per month. The ore in sight in the various properties of the consolidation is estimated at $2,000,000. About 97 per cent. of this ore is mill dirt averaging about $10 per ton, and 3 per cent. is smelting ore averaging in value from $60 to $75 per ton. The mining, hoisting, and pumping bring the ore to the surface at an average cost of $3.25 per ton. It is hauled from the shaft house to the mills, one and one-half miles distant, and reduced, via bullion, into cash at the bank, at a further cost of $1.25 per ton. In other words, the 97 per cent. of mill dirt averaging $10 per ton, is mined, milled, and reduced to actual cash in the bank at 45 per cent. of its gross value, leaving 55 per cent. profit.

The mines and mills of this Consolidation already furnish direct employment to 150 men, although at present development work rather than ore extraction is being pushed. The additional depth of 300 feet now being sunk on the property, viz., from 1,100 feet to 1,400 feet, when opened laterally on all the numerous veins being exploited, will keep the mills of the consolidation running to their full capacity of 4,000 tons per month for six or eight years, without sinking another

foot in depth. Within the next two or three years at furthest, the Newhouse tunnel will have reached the territory of this group, cutting the veins at a depth of about 2,000 feet. It is readily seen, therefore, that this consolidation will be producing mineral at a profit for an indefinite number of years to come. No such results as the above were possible so long as the area in question was a mere segregation of nearly twenty different properties.

The Gregory-Buell consolidation is at the foot of the historic Gregory Gulch and comprises what were formerly twelve segregated small properties, having no fewer than fourteen shafts, most of them comparatively shallow, antiquated, and inadequate. The entire property has an aggregate past record production of $2,000,000. Within the area are ten different veins, one vein ranging from 4 to 20 feet

RUSSELL GULCH, GILPIN COUNTY, COLORADO.

In the foreground the Wautauga mine is on the left, then the Lillian, and on the right the Pollard and Pewabic mills.

wide, a second from 3 to 12 feet wide, a third from 4 to 14 feet wide and the remaining seven veins from 2 feet wide upwards. The group is now being opened up and operated through the Buell shaft, 700 feet deep, equipped so as to have a hoisting capacity of 600 tons per day. The past history of the group shows that at least one-fifteenth of the ore is smelting ore ranging in value from $50 to $300 per ton, the values consisting almost entirely of gold. The other fourteen-fifteenths of the ore is mill dirt ranging from $5 to $25 per ton, with

THE GILPIN COUNTY TRAMWAY.

a minimum average value of $10 per ton, which it is expected, under the circumstances of this property, can be mined and milled for about $2 per ton. Above the 500-foot level in the various properties of the group, it is estimated that there is $2,000,000 worth of ore already in sight, readily accessible by means of levels and prospects from the Buell shaft. Below the 500-foot level down to the present depth of the shaft, viz., 700 feet, it is virgin ground, as also below the 700-foot level, with probabilities of ore, as shown in the California shaft and Newhouse tunnel in the same mineral belt, to a total depth of over 2,000 feet. The group will have its own stamp mill equipped with Gilpin County concentrating tables, also "sizers" and Wilfley concentrating tables, the object being to accomplish a greater percentage of saving of values than is as yet usual in Gilpin County. By means of such consolidation, admitting of business-like methods and justifying considerable expenditures, this group seems destined to become one of the leading dividend-paying shippers of the district for an indefinite number of years. Without such consolidation, it would necessarily have remained merely a series of isolated dormant properties.

There have been other similar consolidations effected such as the Kansas-Burroughs, representing English capital, and the Ontario-Colorado, representing Canadian capital. There are numerous cases where other similar consolidations might be effected, comprising several thousand feet laterally of known main veins, with several hundred feet in width covering parallel, diagonal, and cross veins; under the management of practical men of local experience, backed by the necessary capital, such consolidations would certainly become regular

ore-shipping, dividend-paying properties and considerable employers of labor.

An important factor in the future development and ore production of Gilpin County is the series of tunnels now being driven from the vicinity of Idaho Springs to cut the Gilpin County mines at depth. Idaho Springs on the South Fork of Clear Creek and the Georgetown branch of the Colorado & Southern Railroad has an altitude of 7,543 feet. The mining towns of Russell Gulch and Nevadaville in Gilpin County, but a few miles distant in a direct line from the Georgetown branch of the Colorado & Southern railroad, have an altitude of nearly 9,000 feet, with surrounding hills still higher, covered with mines. It is self-evident, therefore, that the series of tunnels now being driven from along the line of the Georgetown branch of the Colorado & Southern railroad will cut the veins of the mines in Gilpin County at great depths, with the following results:—(1) Such mines will be automatically drained and the serious cost of pumping thereby dispensed with. (2) The ore can be mined at the minimum of cost, the serious expense of hoisting being dispensed with. (3) The ore can be taken from the workings in the mine, in the ordinary mine car, and dumped into a railroad car at the portal of each tunnel. It is not possible at this time to realize fully or to anticipate the great impetus which will be given in the near future to the mining industry of Gilpin County by the completion of these tunnels, one of which,—the Newhouse—has already crossed the boundary line into Gilpin County, is being pushed at the rate of 250 feet per month, and will from now on cut a succession of mineral veins at short intervals.

In view of the above, it is self-evident that the mining industry of Gilpin County, though dating back to 1859, with a production to date of over $100,000,000 of mineral, mostly gold, is as yet only in its infancy. With consolidation of the antiquated, impractical, small holdings into groups of sufficient extent to justify the expenditure of the necessary capital, combined with new enterprise, new capital, and up-to-date mining and metallurgy, the coming forty years will witness a much more phenomenal mineral output, and the end of the period will still find the district not even arrived at its zenith.

AMERICAN MACHINE-SHOP PRACTICE FROM A GERMAN VIEW-POINT.

By Peter Lüders.

In our Editorial Comment in the October number we explained the regrettable occurrence which caused a break of a month in the sequence of Herr Lüder's articles. We are very glad to be able now to present the supplementary and concluding part of his review. It is, in the field of the machine-shop, what Mr. Dawson's leader in this issue is to steam engineering—a comparative measure of international practice and a helpful influence toward internationalising the best practice, wherever that may have originated.—THE EDITORS.

IN a preceding paper, appearing in THE ENGINEERING MAGAZINE for September last, I began this review with the discussion of the deep-lying differences which exist between Germany and the United States in the matter of social and industrial organisation and labour conditions. I left for this concluding paper the examination of the system of specialisation and standardisation as it affects the practical conduct of the works. But to take up the connection between the first part of the paper and the second one, we may first discuss the American draughting room and everything connected therewith.

About the American draughting room and the work done therein two ideas generally prevail—the first, that the draughtsmen work only six or seven hours a day, and the second, that American drawings as a rule are very poor samples of what they really ought to be.

The belief that six or seven hours constitute a day's work in the States is so commonly held, not only in Germany but all over Europe, that a statement to the contrary would find hardly any acceptance. And I must say I myself was quite surprised to be undeceived in this regard, having held before the ordinary belief; and I still do not quite understand why the Americans have given this question so little consideration and failed to change their practice in this particular in

accordance with all their other new arrangements. It is impossible to do really good constructing work for eight or more hours a day, especially during the American summer. Certainly no one can run a draughting room on a time-keeping system like a machine shop, brain work being not countable by the hour. But nevertheless some time-keeping-like statistics could be drawn up in regard to the work accomplished in the draughting room and the result thereof would be quite surprising. In Germany there are now some works where the draughtsmen work only from nine o'clock in the morning until three in the afternoon, without dinner time. They are allowed to eat something in the meantime, just as American workmen commonly take some luncheon during working hours, but no one is permitted to leave his work for the purpose. And the statistics of these places have shown clearly that the work done thereat was done with double the pleasure and the interest displayed before, but in half the time only. And I think that to be quite natural, every one of the men feeling that he is treated as a human being and not as a machine. But if the draughtsman is confined the whole day long in the drawing room, he will never find any time to make progressive studies and to increase in this way his capacity of doing good work for his firm. On the contrary, he gradually loses interest in his work, commences to do many things in the draughting room which he ought to do at home, and thus shortens every day his eight office hours more and more without increasing his work.

But all of this affords no sufficient reason for the idea that American drawings for the most part are but very poor approaches to what they really ought to be. I think it would be more natural to conclude that where such a class of work is produced as that which comes from America, there must be first a very good foundation for it, and for the machines surely the drawings form the necessary foundation. This fact, I must say, the Americans have learned to appreciate and have done everything they could to get nothing but the most excellent work out of their draughting rooms. Certainly no one will say that German drawings do not represent first-class work in every way—work of the most painstaking care; but that is by no means the most important point. The main question always must be to get drawings made out in absolute accordance with the general character of the work and its management. Only thus can time, labour, and trouble or useless expense resulting therefrom be saved and prevented, and at the same time real progress be achieved. And I must say the drawings I saw were made with a very close and careful observation of the condi-

tions stated above. They show not a bit more than is necessary, and are thus all very easy to be understood. The original drawings never come down into the shop, but only blue-prints from them. The original drawings, not painted or coloured, nor even inked as is done by the Germans, but nevertheless just as fine work of the most elaborate study and carefulness, are kept up in the draughting room, in a safe or fire-proof drawing storage room. But with the blue-prints they are really not stingy. No workman has ever to run about and to search for a drawing, or to wait till his comrade gets through with a drawing. every one of them having his own. These blue-prints of course are numbered, probably just as they are everywhere else, but generally (as at the Pond Machine-Tool Company) they are also pasted onto a board or a plate of sheet-metal, thus lasting much longer and being always ready for use. A special office takes care of all these blue-prints and there every workman can get every drawing he needs, depositing, as a control, a check giving his own number.

How different are the conditions in some of even the largest German or European works, where even at the present day very often one drawing has to be used by several workmen at a time! There they stand around, disputing as at a meeting all the different meanings and possibilities of meaning not only of the drawing, but of some hundred other things not at all connected therewith. But this is not the only trouble. Very often the drawings do not answer at all the needs of the work, or contain everything else except the latest information. And the reasons therefor are two. The first is one affecting the chief engineer, and is simply that he is overburdened with the details of correspondence; instead of having to do as little writing as possible, thus getting a chance to follow up every improvement made anywhere in his line, he has to divide up his time between his constructions and his correspondence, and unfortunately the first mostly gets the worst of it. The second is that the draughtsman, in a large number of works, hardly gets any chance to see his own constructions really worked out or hears any of the complaints made either by the foremen or the workmen. These complaints are very seldom taken as possibly containing good and useful advice from a real practical man. On the contrary, they are usually counted for nothing, as being made by a man of far lower standing than any engineer ever can have been at. And so I think it would be absolutely impossible to create in Germany or Europe an institution like that, for instance, at the Dayton National Cash Register works, where prizes are given every year for the best improvement or suggestion made by any one of the employees.

Nearly the same thing which has been stated before concerning the co-operation of engineer and workman, will hold true for the factory itself, with all its departments. If the departments do not work together, supplementing one another as much as possible, the work done in the shop will be just as useless as any work done in the draughting room under similar conditions. That again the Americans thoroughly appreciated and so they have built up a complete system to meet all the requirements imposed by these conditions. And just this very system, consisting of the three main parts "standardisation, specialisation and transportation," the other nations come to study. They try to understand it, to adopt it, or simply to copy it.

At first "transportation" seems to have little to do with standardisation and specialisation, but nevertheless it has proved in American works to be just as important as the other two parts, if not even more so. Only with a very carefully arranged system of transportation can the work be made to run as it must, if real success is to be secured. In other words, standardisation and specialisation can be fully carried out only where there is a good system of transportation. Therefore it will be interesting to make at least some study of that system.

The main idea for all the arrangements connected with transportation has been and for the future too will have to be, that no piece whatever shall be handled twice, or backwards, which will be the same as allowing but one direction of movement for every piece under work, the way straight in, straight through, and straight out of the works. Straight in to the main office, to be calculated there and placed under construction as quickly as posssible; straight through all the different shop departments, from one machine tool to another without any useless delay; and at last straight out of the inspection and shipping department. And in that connection, some—if not even yet most, of the American works are model shops, where everything shows that every possible good point in that line has been taken into as careful consideration as possible. For their cranes, for instance, they use as driving power nearly every kind of power obtainable. There are hand, steam, electrical, or air-driven cranes, all running with quick motion in every direction and all, especially, constructed in accordance with the general character of the work they are to be used for. One of the latest constructions of that kind is the pneumatic or air hoist, and hardly anything will be more striking to the European visitor than for instance a modern American foundry, equipped with these cranes. How strange to see the foundry as a large, well-lighted and well-ventilated as well as heated hall, so that even in the hottest or coldest

weather it is never an impossibility to work in it, and especially to get the whole year round the regular amount of castings done. Sometimes each one of the moulders, sometimes every two of them, have one hoist for their own. The hoists are travelling ones, connected with a small wheel running on a single track, close to the roof of the building, can easily be moved from one place to another, and are everywhere immediately ready to work with. But it is not only that which makes these hoists so far preferable to any other form used before in any foundry, but particularly their being free from any roughness of motion. When started, the air hoists lift as slowly and as steadily as could be desired, and at the same time can be stopped at any desired height and later on started off again. That fact, together with excellence of construction, has made the standard types of these lifts pretty nearly an absolute necessity for every real competitive modern foundry. I hardly know of any European foundry using this system in the way in which it is applied in some of the leading American foundries. And here may be mentioned still one more not less practical arrangement, in some ways supplementary, at least so far as the general completeness of the equipment is concerned, to the air hoists just mentioned; I mean the overhead tracks or trolleys by which all the metal is carried directly to every one of the moulders, none of it being caught at the cupola, but leaving the moulders, with the exception of a very few, right at their work, thus saving a good deal of trouble, time, and cost.

The cranes and hoists serve simply to handle the goods on the one floor; elevators are used to carry both human beings as well as any material from floor to floor. The works were already arranged so that no workman should lose time searching for a drawing, there being only one place where it could be; now further provision is made that he shall save every minute by taking the elevator instead of climbing up a staircase. Thus the American elevator is no more a luxury but a time-saving machine, just as necessary for every factory as any of the machine-tools, and therefore there is evident just as much care and attention in its construction and its introduction wherever needed in the factory.

But besides the cranes and elevators there are still three other parts of the transportation system, which have to be named as time savers —the bells, the small shop carriages, and the boys. All over the shop push-buttons are installed, and it costs hardly any time for any one of the workmen to reach the next one and to press the button. All the bell circuits come together at the tool room or the general store room,

and for every call a boy will come to see what is needed at the place the call came from. In this way for every workman all useless walking about, and stopping here or there for a short talk or anything else, is brought definitely to an end. The boy then goes to ask the foreman to come and see the piece under work, or gets the drawings, the needed tools, or whatever may be required, as quickly as possible, while the high-waged workman still keeps on working, thus saving every minute. Supplementing the bell and the boy are the small three- or four-wheeled carriages, taking away all finished parts, keeping and carrying them from one department to another, until the whole machine, divided up in all its details, is put on there, and the whole load goes to the inspecting and erecting departments, to receive there the very last finish before leaving the work. This system of handling business has for instance shown most profitable results at the Brown & Sharpe works, at Providence, R. I., as well at the Cincinnati Milling Machine Company's works at Cincinnati, Ohio.

So much for the system of transportation, without pretending in any way that there are not a number of other very interesting and noteworthy arrangements in that line not mentioned here, simply on account of lack of space.

Next to transportation, standardisation and specialisation were mentioned as forming the basis of the American system of managing an up-to-date works in an up-to-date manner. But before taking them up in detail, a clear understanding will have to be reached regarding the meaning of the two headings; a misunderstanding of this matter prevails to a great extent nearly all over Europe. The general idea there is, whenever American works in general or American shop management methods especially are called into discussion, that standardisation means simply sticking forever-and-a-day to a single form of construction, once recognized as being a good one. It really means finding out which parts, of as many different machines as possible, can be made in every way alike, thus keeping the cost of production as low as possible. And specialisation is taken to mean simply building only one kind of a machine, may be in a few different sizes, while the true meaning is rather finding out the most simple and at the same time the most perfect way of producing the standard pieces, thus easily defeating in cost and workmanship every possible competitor, who does not believe in nor practice this policy. Thus Europeans have the feeling that the Americans generally are rather to be pitied for being limited—or rather, for having confined themselves—to such a one-sided way of doing business. And the next step to this conclu-

sion, with rare exceptions, will be that if anything is to be avoided, it is this way of stupefying constructors and manufacturers. So they throw the whole system overboard instead of trying first to get a better understanding of the reason the Americans may have for running their works on a system so very much different from the one used anywhere else, and then possibly to adopt at least parts of the system, carefully avoiding everything that could be to any disadvantage to them under general European conditions as between manufacturers and workmen. And so this paper may in its conclusion give in condensed form an outline description of the general layout of an American machine shop, thus showing the system in its most interesting details, leaving it to every one interested therein to adopt for himself what he may believe most profitable to his particular condition.

The system itself certainly depends entirely on the general character of the work to be produced, and must therefore be quite different where on the one hand either heavy or light work may have to be done, and on the other hand where the work will always be of the same kind and character, or where it varies greatly and widely, both in material and construction. But a system will be possible in every one of these works, work being always at least in some sense repetitive so long as flat or round, large or small, pieces have to be worked out, and so long as it will be possible to divide those pieces up in different departments, each department best fitted for its kind of work. And there the Americans are again far in advance, teaching every other nation what it means to figure out these departments with most elaborate care, looking forward both to the best workmanship and the general success of the whole works. But if this department system is really to become as useful and valuable as it has proved and still proves for most American works, every piece of work will have to be taken into a good deal closer consideration, as to its best and cheapest way of production, than is now the custom in most of the factories throughout Europe. No piece whatever can be given to any department, before it has been proved by experiment or experience where it can be produced with the least actual cost—that is, where it can be done with the least depreciation of the machine tool or the tool itself. Besides this, the work must be done in such a way that hardly any special finishing work of any kind will be required. Further, all parts of the same size and make must be absolutely interchangeable, which means finding out where and how to use best jigs and fixtures to the greatest advantage in accuracy as well as in saving of time. Next after choosing the most suitable machine tool, if possible the department best situated in

the shop in regard to power transmission or handling will have to be chosen, so as to save in this direction also every possible penny.

If all these points are considered as they ought to be, the planing and milling department will be used nearly entirely for all kinds of flat work, these machines being most adapted to get absolutely true flat surfaces. And there again special care has to be taken in deciding which pieces will best be planed or milled, some firms believing it quite possible, if not necessary, for heavy work as well as for light, to do on the milling machine at least three-fourths of all the work formerly done on the planer. So at Brown & Sharpe's the milling machines are far preferred to the planers, while at other places just the contrary may be noted, or both methods may be equally employed. And as in studying economy of production of the flat parts, all milling and planing work were taken into one department and placed under one inspection, so the round parts are handled together in the boring, chucking, and drilling departments. Sometimes it will be quite possible to combine these three departments, as least as long as mostly only small parts have to be made. In cases where there are mostly heavy parts under construction, the combination will be impossible, simply on account of the general differences in weight and construction, as well as in need of driving power, between the heavy boring and drilling machines and the comparatively light chucking machines. But no matter if the departments are combined into one or not, if good, cheap, and true work is to be produced, it must be stated as a law, that no hole whatever shall be made at any other place of the factory, the right machine tools for all work of this character combined with the right inspection being found only here. And nowhere else will good and careful inspection be as profitable, untrue holes being the most hampering difficulties of all for the erecting and fitting department.

So far we have considered work in which every piece calls for a special workman, and generally a thoroughly skilled one too; or, in other words, work on which one man could run only one machine, and he ought to have a good deal of experience on his machine if his work is to be really good. In these cases automatic machines—that is, the very best time-saving appliances—are of but very little use. But where the general character of the work admits an extensive use of these automatic machines, there must be employed in connection with them the same care and regard for every good point obtainable as is expended upon any of the other machine tools. In this class the turning, the screw-machine, and the gear or rack-cutting departments may be the most interesting and important ones.

The automatic turning machines—by means of automatic lathes mostly—running with fast feeds and taking heavy cuts, are a very good factor of the blacksmith shop, effecting a great saving in coal formerly used in heating up long and thick pieces, and a great reduction as to wages for the blacksmith as well as his helpers, while shortening the time formerly used in useless forging and cutting-off work. The automatic screw machines for making screws, nuts, bolts, pins, studs, and washers, from the smallest up to the largest ever needed, are one of the most ingenious machine-tools ever constructed. These machines have done away with a very great part of the expensive fitting, filing, and polishing work, besides rendering one man able to run several machines at a time and every one to its full capacity if necessary.

The automatic gear- and rack-cutting machines are quite different, but by no means less interesting or less useful machines. While the others only effected a saving of time and work in the machine shop, these automatic gear-cutting machines have made the original foundry work a great deal simpler, easier, and cheaper. No gear or rack should ever be cast any more or should be cut otherwise than out of the full material by the use of the very best automatic machine tool especially constructed therefor, thus getting absolutely accurate and perfect-running gears, which is equivalent in many cases to a great diminution in general depreciation as well as in driving power required.

Next to these last three departments, mentioned as being absolutely necessary for the production of all kinds of round parts, the automatic turret machines must be named. These machines are automatic also, at least in the sense that a fixed number of operations can be performed without need of especially replacing a separate tool for each operation. Some of these machines enable the production of work at half the cost incurred before on a common lathe, etc., avoiding all the tiresome setting-up work and rendering it nearly impossible to get out other than absolutely interchangeable work.

As an addition to the departments listed above must be noted the scraping, grinding, and polishing department. All these give the last finish to the work commenced at one of the other places, and are an entirely American machine-shop feature.

The scraping work is done entirely by hand and requires a number of special tools and a good deal of practise, if true surfaces are to be obtained and all useless fitting work practically avoided. Where absolutely round parts or true holes are required, the grinding and polish-

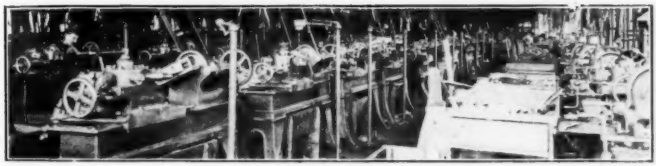
ing machines, as for instance those of the Brown & Sharpe Company, are by far the best machines of their kind. The results gained with these machines, first only on smaller parts, brought it about by and by that in some cases even the largest pieces were put on them, as for instance such work as grinding the journals of the largest axles, as I saw done at the Southwark foundry.

Lastly may be enumerated some departments which will be very useful and profitable in cheapening and likewise increasing and controlling the yearly output of a large modern factory, while not absolutely necessary for a smaller but still equally well managed firm. These are the assembling department for large or small parts, together with the very important, but in Europe unfortunately so very often quite neglected, storage room for finished parts as well as for those under work, if possible or necessary. Next, the cutting off and centering, combined with the hardening, tempering, and annealing department, serving to prevent on the one hand useless carrying about of the stock material, and on the other hand to send only best prepared parts out to the different departments. Last, but practically the most important department mentioned, is the laboratory. It is quite surprising to observe how long a time it took for even the most intelligent machine-shop managers to get an understanding of the enormous importance of such an institution as a well organised laboratory. The first steps in this direction are made now for instance at the Midvale Steel Company, at the Niles Tool Works Company, and at a few others of the largest firms. But it will take still a considerable time before these laboratories and their followers will be in a state to be a real help to the machine shop, and the figures obtained therein will actually form the basis for conclusions which should be drawn as to the character of the material to be worked on before ordering any machine tool. It may be that through their work a far better understanding will be arrived at on both sides of the Ocean as to the requirements of the builder, as well as the customer, in regard to the construction and the advisability of the different machine tools.

Before concluding this paper it must be said that as all items mentioned have of necessity been briefly treated, some others have not been mentioned at all, simply on account of being by far too important to be dealt with at the same time. So in many cases the success of the whole works depends not least on the foundry and its management, and just therein the European machine-tool builder as well as every foundry-man can learn a great deal from America how to run a modern and competitive foundry. Further, I have left out of considera-

tion the real soul of every works—the entire accounting and cost-keeping system.

The conclusion of the paper then may be reached with a warning to the Americans as to the way they educate their boys right in the works. To-day there is a boundless need of planer or lathe hands, and with the automatic machines nearly anybody can do the work formerly done only by a "thoroughly skilled man." So it has become quite common to use the boys first only as shop messenger boys, keeping them trotting about the whole day long without giving them any chance to do even the simplest work of a helper. Later on one of the planer hands takes hold of one of the clever ones and puts him on his job as his helper, but unfortunately never sending him out again, sending him down to the erecting floor, or giving him some lathe work to be done. So the boy becomes again a planer hand and calls himself pretty soon a skilled one, while he actually has no skill at all. The end thereof will be that the skilled men will get more and more rare, while the so-called skilled ones will be in abundance. But at the same time all progress will be stopped, only the thoroughly skilled man being able to give good suggestions for real improvement on the machine-tool he is operating. And if these suggestions cease to be made, the engineer will lose the very best help for progressive work on his part, and so finally the model shop and the automatic machine will bring death to their users, instead of pulsating life.



THEORY AND PRACTICE OF ESTABLISHMENT CHARGES.

By A. Hamilton Church.

V.—FACTORY AND MASS PRODUCTION AND THE NEW MACHINE RATE.

Mr. Church's first article, which appeared in our July issue, dealt with the vital necessity of accurate cost keeping. His second paper analysed the chief accepted methods of apportioning general expense to individual jobs and pointed out their deficiences, and in the third article he developed a comprehensive and accurate system. His fourth paper discussed the classification and dissection of general expense. The concluding number of the series next month will review the entire field of establishment charges.—THE EDITORS.

HITHERTO the case of an ordinary engineering shop has been under discussion, in which each production centre is in charge of an operator, whose wages form a separate item of cost. We have now to regard the case of factory production, in which it may not be profitable or necessary always to be taking out cost, because there is here not so much a question of separate jobs each different from the other, as of batches or lots of similar or closely similar articles going through time after time without variety in pattern.

It is also in connection with this class of work that we usually meet the automatic or nearly automatic machine, which introduces new difficulties into the question of costing, if not of shop charges. Take for instance the case of a group of small turret machines making some particular piece, for which the call is not absolutely constant. We will assume that there are five machines in the group, under the charge of one man, who sets tools and attends to all the wants of the process. Some of the machines are always running, but the number varies from, say, three to the full five. What is the cost of the work under these varying circumstances and what the proper incidence of shop charges?

The usual plan of taking out prime cost by means of time sheets evidently fails here, since this would lead to the same job being

charged with 1/3 of the man's time today when he was working three machines and with only 1/5 tomorrow when all five happened to be working. It is evident that this result is worthless for any practical purpose. And when it is considered that different articles may be running on each of the five machines, or three alike and two separate, or indeed any possible combination of five numbers, the confusion is still worse. The costs become quite meaningless.

Not so however with the new machine rate. As far as any particular job is concerned it is a matter of indifference if one, two, or all the five machines are in operation simultaneously. Whatever work is done receives its due debit of charges strictly in proportion to the time it takes. It is not even necessary that all the machines be exactly alike. One of the five may be a larger machine with a correspondingly higher rent charge. This matters nothing; just so much work as is done is burdened with its own proportion of machine rate, and therefore with its share of shop charges, quite irrespective of whether the other four are idle or working. As has already been explained, the idle time on each machine falls into the supplementary rate.

It matters not, therefore, from the point of view of the distribution of shop charges through the new machine rate, whether the machines are automatic or not. An automatic machine is still responsible for rent, interest, floor burden, cost of power, working expenses for oil, or other process supplies, just as an ordinary hand-operated machine is. And there is no difference in the method of determining these charges. If a hand machine were to be made automatic it would not alter the rate, except in so far as the alteration might have happened to alter some of the factors. If these were not altered at all, then the rate would also be unaltered.

But this does not get over the difficulty of the direct wages allocation. The prime cost is complicated by the change undoubtedly. Every machine, however automatic, does unquestionably take up some part of a man's time, and the important point for cost-account purposes is to know what is the usual amount of time so taken up. In the case of a small automatic hack-saw, where the time occupied in changes is inconsiderable relative to the length of the process, no substantial injustice would be done by neglecting the wages factor altogether. But though this might answer in the case of an isolated machine, it certainly would not be fair where several machines are in question; and where the automatic machine is in the direct line of the process-work it is evident that the wages difficulty must be solved.

The plan advocated here involves perhaps considerable breaking

away from traditions. Briefly speaking, it is proposed in the case of automatic machines to consider wages of attendance as a factor of the new machine rate, based on the *maximum number of machines that can be worked simultaneously under the most favourable conditions.*

If, for example, we have a group of five automatic machines, capable of being operated simultaneously by one man, at $10 per week, we consider the proper labour charge per machine per week to be $2, which is equivalent to an hourly rate of 4 cents for each machine. This 4 cents is added to and made part of the new machine rate in each case. It follows, of course, from this that if one or more of the machines are idle, the unallotted wages fall into the supplementary rate along with other shop charges.

The plan of treating the wages on automatic machines as one element in the shop charges, and therefore suppressing their separate existence as an element of prime cost, is justifiable on several grounds. Whether machines are working or idle is a matter of general shop economy, varying according to the commercial situation or the efficiency of organisation. Now, within very wide limits where groups of automatic machines are concerned, it is fairly evident that under conditions of varying commercial efficiency, the number of machines in operation at any one time will vary from day to day, but not the wages bill. Therefore we shall not be far wrong in assuming that the adverse conditions due to slackness are more properly thrown upon the supplementary rate than visited upon the individual jobs. It has just been shown that the wages factor is one of the most variable elements in connection with a group of automatic machines. When all machines are working full time and things are at their condition of maximum efficiency, each job in the case of the five machines mentioned above is receiving a debit of 1/5 of the attendant's wages. When only three of the machines are working, each job done on those machines still continues on the new plan to receive 1/5, and, as will readily be understood, the remaining 2/5 falls into the supplementary rate.

The practical advantages of this are: (1), The prime cost, being wholly composed of the machine rate which includes the wages factor, remains the same under all conditions of shop efficiency; and, (2), the unappropriated charges, including of course the balance of unallotted wages, instead of being visited on jobs which do not deserve to suffer, go to swell the supplementary rate which is, as before explained, an index to the conditions of shop efficiency.

In the case of mixed shops where groups of automatic machines are ranged alongside hand-operated machines, some little care must be

taken in arranging the wages factor as a component of the new machine rate. The wages of each operator must in the mixed shop be divided over such machines only as he is in the habit of working. It will be evident that should a man at a different rate of wages be put permanently on the machines, the machine rate will have to be altered; but in the case of a temporary substitution due to shop exigencies this should not be done. Any difference will be a matter of temporary accommodation, properly thrown onto the supplementary rate.

In the case of a shop given up entirely to factory production proper, such for instance as a grinding or polishing room, the advantages of the proposed method become still more obvious. After the ordinary machine-rate factors have been determined, a carefully estimated average wage rate is added on to the machine rate, and becomes part of it. Now such average wages rate is based, as before explained, upon the largest number of machines that can be worked by any one operator, or in cases where an operator has assistants such wages are added together and then averaged. In any such shop it frequently happens that workers are graded rather by length of service than by competence. The averaging plan gets rid of these anomalies. Where differences in wages are not due to differences in work, it is most desirable that the costs should not vary because a higher- or lower-waged operative has happened to be employed on any job.

In all these cases, the wages of operators which have been reduced to machine-rate factors are debited at the end of the month to the shop account. As this account is credited with all the machine earnings, it follows again that the balance of time not occupied to the utmost efficiency (as for instance in the case of three only out of five machines being worked) remains uncredited and thus is left to be dealt with in the supplementary rate.

The main point of difference between the new and former method may be briefly summarised. In the case of automatic machines, or of regular factory production, the wages of operators are treated as a shop charge, and a factor is added into the new machine rate by which such wages are charged to jobs on the basis of conditions of highest efficiency. A departure from these highest conditions does not reflect itself in the No. 1 cost of the job, but only in a higher supplementary rate distributed as a general shop charge by hourly burden.

When all the machines are running, and consequently the conditions of maximum efficiency are fulfilled, there will be nothing left in the shop account but the really general shop charges, such as general foremen's wages, and consequently the effect will then be the same as

if the wages of each operator were being distributed by time sheets over the jobs he is actually engaged upon.

The principle might be illustrated by saying that each machine is looked on as having a little bit of its operator's wages permanently attached to it. When the machine is working this fragment of wages is transferred to the jobs done, but if it is idle the fragment is transferred to the general shop expenses, and is distributed over the work generally as supplementary expenditure.

Reference has been made to regular factory operations which do not need that costs be continuously taken out. Where machines are constantly employed on the same article, or process, say slitting steel pens, it is not usually considered necessary to keep a regular record of production. Particular days are selected and the output of the machine for that day is taken. This, divided by the number of hours and multiplied by the machine rate, gives the No. 1 cost for the product, plus, of course, the number of hours multiplied by the supplementary rate (hourly burden) if No. 2 or shop cost is required. This being done from time to time is frequently considered to be sufficient check to ensure proper working. Whether it is really so or not will depend largely on circumstances, obviously.

In any case, to work out the figures required at the month end it is necessary to keep for each machine a machine time table, showing the hours during which it has been working. This is summarised at the month end, and the total month's earnings of the machine credited to the shop account. It makes no difference whether the costs per job or per batch are worked out or left unextended. As long as we know the numbers of hours worked, the supplementary rate can be found, and thus the true shop cost of any job, whether all the jobs are costed out, or only selected ones. By using a special form of machine time table, and by sending through the work in regular batches of say, 10,000 pieces, distinguishing each batch by a letter as, A, B, C,. . . . Y, Z, etc., both these requirements can be met at once, and the cost of each batch recorded, even though it is only occasionally collected together in the regular form of a cost account. This can, of course, be done at leisure, without special arrangements. In many respects this is an advantage over the occasional watching of outputs, since these tests nearly always become known and can thus be manipulated by a cunning operator.

Space does not permit in this series of articles of more than the outlines of the method being developed; the presentation of actual forms and accounts both for inaugurating and working the system must be left to another occasion. But as concrete figures and examples

SHOP-CHARGES ACCOUNT, JANUARY.

Debit		*Credit*	
To Interest on machines.....	$53.00	By Machine earnings.....	$576.00
" Depreciation on machines.	53.00	Being total of amount distributed to jobs by means of new machine rates this month. See Table A of "Machine Time Made," below.	
" Power.....	100.00	Undistributed balance,	100.00
" Wages on auto machines (2 operators and overlooker)	75.00	(Supplementary rate = this amount ÷ hours worked, *i. e.*, $\frac{\$100}{4,400}$ = $0.0227 per hour.)	
" Process sundries (oil, etc.)	45.00		
" Debit for floor burden 5,000 sq. ft. @ 5 cents.	250.00		
" Supervision (general).	100.00		
Total debit,	$676.00		$676.00

Total hours made as per Table A. = 4,400.

Supplementary rate this month = 2.27 cents per hour.

N. B.—The hourly burden for this shop on the ordinary average hourly burden plan would work out at $\frac{\$676}{4,400 \text{ hrs.}}$ = 1.54 cents.

TABLE A.—SHOWING MACHINE TIME MADE. MACHINE EARNINGS IN JANUARY.

No. of Machine.	Total Hours Worked in Month.	(New) Machine Rate Per Hour	Earnings—i. e. Amts. Debited to Jobs thro. M. R't	Remarks.
		Cents	$	
1.....	200	4	8	Hand-operated machines. Wages allocated direct to job per time sheet.
2.....	200	7	14	
3.....	200	23	46	
4.....	200	25	50	
5.....	200	12	24	
6.....	200	10	20	
7.....	200	09	18	
8.....	200	34	68	
9.....	200	04	8	
10.....	200	16	32	
11.....	200	9	18	Group 1. Auto machines. Wages part of machine rate.
12.....	200	9	18	
13.....	200	9	18	
14.....	200	9	18	
15.....	200	9	18	
16.....	200	9	18	
17.....	200	15	30	Group 2. Auto machines. Wages part of machine rate.
18.....	200	15	30	
19.....	200	15	30	
20.....	200	15	30	
21.....	200	15	30	
22.....	200	15	30	
TOTALS.	4,400	.....	$576.00	.....

give a very much clearer idea of what is actually effected by the system than any amount of merely verbal argument or description, the remainder of this article will be devoted to the presentation of an actual set of results. They relate to a shop in which many of the machines are worked by single operators, their time being booked direct to the job in the usual way. There are also two groups of six automatic machines, each group requiring an operator, and the two groups are in charge of a special overlooker.

The shop and cost accounts are presented, first, during a period in which the shops were full of work, and secondly, some months later when trade was very quiet. The same job is given under the two conditions, and is also shown separately in the second period, as an improvement in the method of manufacture was made at this time.

COST STATEMENT OF JOB (JANUARY).

10	Hours	machine	No.	9	@	4	cents	per	hour	$0.40
6	"	"	"	8	@	34	"	"	"	2.04
12	"	"	"	17	@	15	"	"	"	1.80
3	"	"	"	3	@	23	"	"	"	.69
Add.									Total machine rates,	$4.93
									Supplementary rate @ 2.27 cents per hour on 31 hours,	.70
									Total shop charges,	$5.63
10	Hours'	wages	@	31	cents	per	hour			$3.10
6	"	"	@	10	"	"	"			.60
3	"	"	@	14	"	"	"			.42
									Total wages,	$4.12
									Total No. 2 or works cost of job,	$9.75

It will be noticed that in this month all the machines made full time; consequently the supplementary rate was very low, viz., 2¼ cents per hour. The contrast between the average hourly-burden plan figure, viz., 15 cents per hour, and the new method, is very well seen by a glance at the Table A of machines. We have here machines which are rated as high as 34 cents per hour, whilst others are as low as 4 cents, this latter machine being a watchmakers' lathe, operated by a highly paid man. These differences in the incidence of shop charges being based on real figures, it is obvious that the new method offers an important advantage in differentiating such different charges as 4 and 34 cents per hour, in place of averaging them all round, as the hourly-burden plan does, on a basis of 15 cents.

SHOP-CHARGES ACCOUNT (NOVEMBER).

Debit.		*Credit.*	
To Interest on machine.....	$ 53.00	By Machine earnings..... As Table A.	$292.53
" Depreciation on machine..	53.00	" Supplementary rate.....	305.47
" Power....	62.00	$305.47 / Hrs 2,187 = 14 cents per hour.	
" Wages on auto machines.. (1 operator and overlooker).	55.00		
" Process sundries (oil, etc.).	25.00		
" Debit for floor burden.....	250.00		
" Supervision	100.00		
	$598.00		$598.00

Total hours made as Table A = 2,187. Supplementary rate this month = 14 cents per hour. Average hourly burden on hourly-burden plan would be $\frac{598}{2,187} = 27.3$ cents per hour

TABLE A.—SHOWING MACHINE TIME MADE AND MACHINE EARNINGS IN NOVEMBER.

No. of Machine.	Total hours worked in month.	(New) Machine rate per hour.	"Earnings"—i. e., Amounts debited to jobs per machine rates.	Remarks.
1.....	130	4 cents.	$5.20	
2	125	7 cents.	8.75	
3.....	86	23 cents.	19.78	
4.....	140	25 cents.	35.00	
5.....	200	12 cents.	24.00	
6.....	200	10 cents.	20.00	
7.....	200	9 cents.	18.00	
8.....	90	34 cents.	30.60	
9.....	200	4 cents.	8.00	
0.....	80	16 cents.	12.80	
11.....	....	....	....	This group was idle and operator stopped.
12.....	....	....	....	
13.....	....	....	....	
14.....	....	....	....	
15.....	....	....	....	
16.....	....	....	....	
17.....	140	15 cents.	21.00	
18.....	80	15 cents.	12.00	
19.....	96	15 cents.	14.40	
20	140	15 cents.	21.00	
21.....	140	15 cents.	21.00	
22	140	15 cents.	21.00	
Totals.....	2187		$292.53	

COST STATEMENT OF SAME JOB (NOVEMBER).

31 hours' machine time (details as before).....	$4.93
Supplementary rate, 31 hours at 14 cents	4.34
TOTAL SHOP CHARGES.....	$9.27
19 hours' wages (details as before).....	4.12
TOTAL NO. 2 OR WORKS COST OF JOB ...	$13.39

In the cost statement it will be noticed that only three items of wages figure, although there are four machines concerned; this is because machine No. 17 is one of the automatic machines, and the cost of operating this is charged through the machine rate, as previously explained in this article. When we come to contrast this job-cost statement with that for the same job in slack times, the further advantages of the method will be seen.

The month of November was a very bad one, the factory was working barely half time. Yet, naturally, the debits against the shop were not reduced in anything like the same proportion. There was in consequence a sharp rise in the ratio of charges to work.

The effect of this can be seen in the cost statement of the job. The works cost of this has gone up from $9.75 to $13.39, although precisely the same machine time and the same amount of wages was expended in the one period as in the other. A glance at the statement tells us, however, that the increased cost is wholly comprised in the one item of supplementary rate, and was not due, therefore to removable causes as far as this job is concerned.

Now on any average distribution plan, whether by percentage on wages or by averaged hourly burden, this information would be lacking. We should see merely that the debit for expenses against that particular job, and its works cost, was higher; but *why* this was so, whether due to variation in process or wholly to increase in the ratio of charges, would not be ascertainable without considerable investigation and analysis. Here, on the contrary, it is seen at once that the debit for machine time—viz., $4.93—is the same as usual, thus allowing us to compare the debits due to variation of process at different periods, quite irrespective of whether the shop is busy or slack.

Apart from the greater precision and accuracy of the method, this disentanglement of the charges for work done from the charges due to slackness is a very considerable gain. It is, in fact, a step nearer the true representation in the accounts of what has actually happened in the shops. By bringing out all natural differences to the full instead of averaging them all down, we obtain a stronger grasp of the situation.

In the following statement the cost of this job for November has come out at $11.35 instead of $13.39. The difference is due to an improvement in method of working. The important point is that neither the wages nor the hours taken have varied; therefore on any averaging system, whether on wages or by hourly burden, this improvement would be absolutely lost sight of, inasmuch as neither of the factors on which they rest has happened to vary.

COST STATEMENT OF JOB.

PUT THROUGH IN NOVEMBER, BUT ON AN IMPROVED METHOD.

10 hours No. 9 @ 4 cents per hour	$0.40
* 6 hours No. 2 @ 7 cents per hour	.42
12 hours No. 17 @ 15 cents per hour	1.80
* 3 hours No. 7 @ 9 cents per hour	.27
Total machine rate,	$2.89
Add supplementary rate 31 hours @ 14 cents per hour	4.34
Total shop charges,	$7.23
10 hours' wages @ 31 cents	$3.10
6 hours' wages @ 10 cents	.60
3 hours' wages @ 14 cents	.42
Total wages (same as before),	$4.12
Total No. 2 or works cost,	$11.35

* Altered process. Compare with former statements.

But a glance at the job in the form presented here is sufficient to show what has happened. Wages are the same, supplementary rate is the same, but the debit for machine rate is less. This leads us at once to the nature of the change, which has resulted in an economy. It is that in two cases, a less heavily rated class of machine has been substituted for those in use before. Machines at 7 and 9 cents per hour have superseded machines at 34 and 23 cents per hour.

On no method but a machine-rate method can differences of this important class be made visible, and no machine-rate method is in itself complete or advisable, unless accompanied by the device of the supplementary rate to absorb and deal with the idle time. But with these combined the resulting method is not only more accurate, but fulfills functions which are entirely missed in other methods.

In the next article, (which will conclude this series,) the question of general establishment charges, i.e., those due to the selling organisation, will be dealt with, and some remarks will be offered on the proper uses and digestion of costs and establishment-charge accounts.

THE ENGINEERING MANAGEMENT OF INDUSTRIAL WORKS.

By William D. Ennis.

The vast material progress of the last half century has been the direct result of entrusting more and more of the executive management of enterprises to the engineer. The man scientifically learned and practically trained in the utilisation of forces and the handling of materials has assumed his reasonable and proper place in organisation and direction, as well as in design and construction. Mr. Ennis shows on how sound a basis of common sense this policy is founded, and argues ably for its extension on purely economic grounds.—THE EDITORS.

THE supreme control of industrial enterprises, including the general management of all phases from the purchase of supplies to the sale and delivery of finished product, is classically in the hands of the expert accountant. The line of promotion in the past has been usually from the book-keeper's desk toward the higher chairs. An innovation was practised, when, instead of the clerk, the private secretary, or stenographer of higher degree, who of all others had opportunities to become familiar with the motives and methods of his chief, was marked as the legitimate successor of that chief.

A still more marked innovation has lately been evident. The managers of to-day are technicists. Engineers—mechanical and civil—make it their ambition to become, not consulting experts, but executives. Among military and naval cadets, the most brilliant and successful students eagerly enter the engineering corps of the service, and become in after years the most thorough and successful officers. The same tendency is pervading commercial life. To refer to a single one of the older American engineering colleges as an example—the Stevens Institute of Technology, in New Jersey, founded in 1872 by an engineer: of the 600 graduates prior to 1896, 230 (or 38 per cent.), were in 1900 occupying positions not technical but executive. The functions of many others who fill nominally professional offices are in reality purely those of management. The chief engineer of a large manufacturing company often becomes as little of an engineer (excepting in his methods) as his typewriter.

This state of affairs is becoming more and more prevalent. The managers of street railway, gas, electric-lighting, and similar companies are, in the main, men of engineering training. The general management of broader manufacturing industries is being concentrated in the same direction. The departmental organization of commerce requires men who shall be, first of all, able executives—second, experts in the departmental work. In all excepting purely specialized branches—such as the legal or financial—use is being made of the trained engineer. Salesmen of mechanical goods, railway transportation-department officials, and incumbents of many other apparently unrelated fields, are made from engineering timber. The highest executive positions in the great industries are accessible to men of mechanical training and common sense.

The United States are confronted with an era of industrial consolidation, of which we have thus far seen but the inception. A line of succession must sooner or later be established, leading to the posts of responsibility. These consolidations may properly be viewed as just so much labor-saving machinery which, like similar developments of the past, have met with much unintelligent condemnation, and which have been rendered possible to no small extent, because of specialized engineering talent.

Much of this is due to the almost invariable consequences of engineering training. It gives thoroughness first of all, for no progress is possible in mechanical operations without thorough mastery of each step. It gives a command of details. It develops a graphic habit of thought, an ability to picture abstract things, and to make mere conceptions real. It emphasizes the necessity of recording, transcribing, comparing, and perfecting one's observations until the elementary facts have been clearly sifted out and the basic principles mastered. And at no stage, especially if coupled with rational and competent scientific study, is it other than broadening to every faculty of the mind. More than all these, it creates the courage and ability to grapple with new conditions with a confidence born of a thorough understanding of the natural laws involved, that unerringly define, limit, and control even uninvestigated phenomena.

The fundamental engineering concept is that of efficiency—the quotient of work performed by work imparted, of value by cost, of effect by cause. This concept is fundamental, not in engineering alone, but in every phase of business management. A cost-keeping system may be never so accurate, but if it stops short at dollars and cents on record, it lacks life. Beyond this point—where the analy-

sis is of value only as a comparison—there is the question of what each particular cost *should* be, or the question of a theoretical efficiency toward which experimental efficiencies must constantly approach. It is not sufficient to insist that costs shall bear a constant ratio to output. The ratio under ideal conditions must be determined by calculation, and should be gradually but steadily approached in practice by bringing about conditions resembling ideal ones. With a few conspicuous exceptions, neither the expert accountant nor the stenographer is qualified by his training to perform such calculations.

In the broadest sense, the efficiency of a manufacturing industry is equal to its receipts divided by its expenses. This industrial efficiency is, however, the product of the several efficiencies of the departments in entire production, in each of which there must be struck a balance between commodities furnished to and by it. With each department normal, the combined efficiency is normal; and an abnormal condition of things shown by the sum total can only be satisfactorily analyzed by one who can apply the touchstone of his own training and experience to the offending element.

The three processes,—consumption, manufacture, disposition of product,—form two gaps for loss. Incompetent superintendence of plant makes the first element high, unintelligent sales keep the third element low, both in proportion to the second. To reduce both losses to normal (when that normal has once been ascertained) there must be quantitative knowledge of the operation of all three departments. This knowledge must consider not only the bulk of commodities in each, but their cost or value as well. The former data—consumption of raw materials in pounds or feet, product in units of weight or measure, sales in gross—furnish a key to the efficiency of the department chief, the superintendent, and the salesman, respectively; but the cost of raw materials, the value of product, the profits on sales, are the measure of the individual competence of the purchasing agent, the manager, and the capitalist. Into the problem enter at least six factors of personal efficiency.

One of the first lessons in engineering training is that of continuity of records. The operation and economy of machinery must be measured from day to day—sometimes from hour to hour. Wastes must be anticipated, and prevented rather than cured. Possible economies must be perceived sufficiently in advance to permit of making the proper preparations to realize them. No possible training could be more typical of what is required from an executive head.

The cost clerk discovers these things only after they have passed into history. His lessons are learned too late. If the engineer or superintendent is pre-eminently obtuse, the cost clerk may be able to tell him things that he has himself overlooked; but the average competent man of the former class will have gone all through the battle and have gained his experience before the figures reach the office.

He learns, as well, the tangible value of an experiment or a test. It may be worth a considerable loss merely to know and recognize the conditions which make for such loss.

In every industry, there must be an ability to retain a constant record of, and acquaintance with, the variations in efficiency. The yearly balance sheet is not sufficient. The economy of the plant must be known for each month, each week, and each day. This knowledge must include the consumption, production, and disposition, in units of quantity and of value. The working day should not close without a calculation of what the record of that day has been, in every department. It is never impossible to obtain the data for such knowledge, although at times it may be expensive and a matter of some complication to do so. The system, if one of approximation, must be fair, so that consumption of raw materials can be apportioned pro rata with output without injustice. It must be reasonably accurate, so as to agree with monthly cost statements; it must express and weigh all conditions affecting the data obtained.

For comprehensiveness, simplicity, and accessibility, columns of figures cannot compare with graphic charts, such as the engineer uses in recording his experiments. These are sheets of ruled paper on which a small circle may be marked to represent the figure, in units of quantity or value, for the day. The horizontal intervals of the chart represent intervals of time, the vertical distances indicate amounts. The circles are joined by straight lines, forming a broken thread which offers at a glance a detailed history of the fluctuations of each item for the month or year as the size of the chart may permit. Such a diagram is familiar to every engineer; but its value to him, while great, is small in proportion to that which it may possess, under intelligent adaptation, to the man who must know quickly and accurately the entire structure and conduct of his business.

The engineer is taught to maintain and resort to his note book. Into this go his observations, experiments, rules, tables, and data. It grows in value from year to year. He finds in it records that save him useless experimentation and prolonged investigation of once-tried suggestions. The executive, too, must have his note-book, per-

haps a thousand times more expensive, possibly less convenient. It may take the various forms of card indices, portfolios, scrap-books, or filing cases; but if used as the engineer uses his records, it will save time and money. It will prevent simultaneous or repetitional empiricism in all the lines of industry under control. New methods and systems of production, new grades of material, new schemes of extension, new policies and announcements, can first of all pass inspection in the light of this collection of facts.

The most elaborate command of details is weak without rational classification. All the factors in the three assumed departments must be grouped with regard to quantity, cost or value, relations with other commodities, and relations to totals. Revenue or expense must be credited or charged to the proper department, especially where there is an interchange of departmental services. Extraordinary revenue or expense (all outside of the purchase of supplies and the sale of product) should be justified by complete analytical figures and data, showing the causes and consequences, not only for memorandum, but as a possible factor in affecting the value of the plant and good will as an asset in trade.

These methods of successful management are not dependent upon unusual talents or abilities, but rather upon high and rigidly-adhered-to ideals of conduct and usefulness. They involve a patience with and command of details; the ability to grasp salient points, to analyze and classify data; readiness for emergencies and unfamiliar conditions; a progressive spirit; resourcefulness, of self and in subordinates; and, more than all, the faculty (and desire) to use men of ability by gaining their interest and co-operation, and, having ascertained their most efficient field, by trusting them without interference.

As an employer of labor, the engineer takes neither the cold and heartless attitude of the old-school manufacturers, nor the more modern and sometimes (on paper at least) excessive altruism of the theorist. He looks upon these subjects with common sense. To him, his subordinates are human, and interest him. He is frank and courteous among them, but he measures their value, in the ultimate, as he would that of a steam engine, by their efficiency. If they fail to meet that test, his duty impels him to see that they step down and out for more efficient and deserving men who will add to the sum total of human wealth and happiness instead of decreasing it. He readily learns, and never forgets, to separate his business wholly from all relations—social or otherwise—that interfere with or hamper him in its conduct.

One of the most striking of recent industrial developments is that of the interchange of information. In this, the engineer has been a leader. For many years his societies and institutes have formed meeting places for men who, while possibly keen competitors in commercial life, have yet found it to their mutual advantage to exchange views, records, and opinions. No other profession has been so quick to overcome personal and selfish motives in this respect. Manufacturing companies are beginning to share the same blessing. For many years, allied interests, those whose directorate to a large extent may have been identical, have exchanged information regarding common problems. In the United States, the Edison electric illuminating companies have long maintained a society for the specific purpose of effecting such exchanges; the fruits of the work being (nominally at least) not for the benefit of outsiders. More lately, interests which, while not allied, were at least non-competitive, have found it to their advantage to confer with one another—principally, perhaps, with regard to the purchase of machinery—so that at present it is quite common for a firm to answer dozens of letters weekly from parties who have been referred to them regarding their experience.

Still more recent is the development of a practice of exchange of information between strictly competitive enterprises. A striking example of this is in the well-known American railway associations, in which the motive-power men meet yearly with the full sanction and approval of their respective roads, and confer freely with their business rivals regarding economical methods of railroading. In other fields, too, the same practice is being followed with success. Even two adjoining manufacturers—keen competitors for certain lines of trade—will confer, with no intention or desire to agree upon prices, but simply to compare notes regarding troublesome details of the business. There is safety in this, as no man can have an absolutely certain knowledge of his own costs, nor proof positive that his customer may not be deceiving him. An opportunity for competitors to compare may be of mutual benefit in giving to the one information that will prevent him from making an unprofitable quotation, and for the other obviating the necessity of meeting an unprofitable quotation in order to retain the business.

In the development of a spirit of co-operation such as has thus become prevalent, the examples of the engineers' societies and of the personality of their membership have played no small part. In the ultimate fruits of this development it is probable that the engineer will be a leading figure.

PROSPECTING IN WESTERN MEXICO.

By Theodore S. DeLay.

Mr. De Lay, in an introductory note transmitting the following article, explains that it is dedicated "to any man who contemplates a prospecting expedition in Mexico. The aim has been to point out and explain such of the conditions of the business as are peculiar to Mexico. If anyone, after having perused the pages, should find himself thereby better able to cope with the difficulties of such an expedition, a rather unprofitable experience of the writer will not have been wholly fruitless." Mr. De Lay has the happy faculty of investing his article with the breadth of interest which makes it unusually pleasant to read, and profitable beyond the strict limits which he proposes for it.—THE EDITORS.

ANTICIPATING a probability that some one will find the opinions of conditions and people, which I may set forth in this article, different from those which he has formed from his own experience, I have to say that there are various conditions and people in the universe, and it is only reasonable to suppose that Mexico may contain several different kinds. I shall attempt to give an idea of such conditions only as I have found, and such people as I have happened to meet, in a limited experience in prospecting on the Gulf of California coast.

I could not advise any one to start to Mexico seeking a high-grade proposition which may be worked with small capital. My opinion in this is based on the following facts:—

A more or less scientific system of mining and metallurgy was practised in many localities in Mexico long before the California discoveries gave American mining its great impetus. These operations were carried on under the supervision of the priesthood, and for the benefit of the church. At that time the population of Mexico was fanatically religious; therefore, anything pertaining to the interest of the church would attract the interest of the public at large. These ecclesiastical mining plants did not require a special and exclusive class of operatives, but employed any and all of the communicants who were not otherwise occupied. It follows that nearly all the laborers of the country would, at some time or other in their lives, be employed in mining operations.

In later years the American and German miners have made Mexico a field of operations, and have installed comparatively recent methods. Some of the first successful plants for the Russel hyposulphite process were located in Western Mexico, such as the San Marcial and La Brancha plants, while at La Dura there is (or was, in '97) the best concentration plant I have ever seen. These foreign enterprises have been no respecters of persons, as regards their native laborers, employing the first person who appeared to fill a vacancy; and since a few dollars in hand makes the average Mexican laborer too rich to work, vacancies were not infrequent. From all of which it follows that the conditions have been favorable for a general dissemination of practical mining knowledge in Mexico.

Now, the Mexican, while not of strong mentality, has the faculty of observation strongly developed by close contact with nature, and has the capacity for accurate imitation characteristic of all semi-civilized peoples. Hence, we may expect to find him a good off-hand judge of ore, quite skilful in tests with the "batea" and horn spoon, and even able to supplement these with rough roasting and amalgamating operations. In nearly every Mexican home, however lowly, one will find specimens of ore, with which the children play while they listen to the talk of their elders about the fortunes which have been gained by the turning of a stone. The Mexican is as patient as his burro—content with little to eat, and less to wear. Hope springs ever immortal in his breast, and he is possessed of a distaste for continued labor with sure results, and a fondness for trying his chance with the fickle dame, Fortune. These two latter characteristics are a basis for the gambling temperament, which is a prime requisite of the adventurer. Lacking the qualities of courage, energy, and industry, our "Greaser" has nevertheless some very good points for a prospector and miner on a small scale.

In a country over every foot of which men of the above character have been roaming for generations, either directly in search of mineral or as herders, yet ever with an eye open for "*piedras ricas*," there is small chance of there remaining anything which can be seen at surface and worked without capital. One is continually surprised at the thoroughness with which Mexico has been prospected by these "*gambozineros*." I have many times found myself in a country so wild and desolate that one would be justified in supposing that it had never been trodden by the foot of man, yet a search over a few acres would generally reveal a prospect hole. But the *gambozinero* is not tenacious of purpose, and rarely follows a vein far after he has lost the pay, so that

there is opportunity for someone with capital to take up and develop an old mine which has once paid, and may again pay with depth. The Creston, Colorado, and Pietras mines are all of this class. The Mexican is not posted on the most economical metallurgical processes, nor is he careful to get the best results from the processes which he knows. So long as his operations pay well, he gives himself little trouble if his tailings do run high. There is, therefore, a chance of finding some old bed of arrastra tailings, or the slag dump from some ancient smelter, which will pay well for reworking by modern metallurgical methods. The Mexican Metallic Extraction Co. (branch of the McArthur-Forrest Syndicate) has several plants in western Mexico, where large returns are realized by cyaniding old arrastra tailings.

The Mexican is unable to treat low-grade ore, and he is neither able nor inclined to dig very deep on a low-grade vein in the hope of its becoming rich with depth. So there is always an opening to work low-grade veins and to block out sufficient ore to make it sell to a syndicate; but that takes money. Another line in which there is, or was some three years since, an opening for a mining man of some means, is ore and metal buying. The ore buyers rob the native miner, and one could over-bid them and still make large profits.

There are the above chances for success on the part of a prospector. There are probably others which I have not observed, but I can safely advise any one not to go to Mexico expecting to find the wealth of the Montezumas kicking around under-foot. Don't follow the stories of "veins of rich ore, basking in the light of the tropical sun, and waiting for Anglo-Saxon knowledge and energy to develop them." There is probably no known ore of gold or silver, carrying over twenty dollars per ton, the approximate value of which the Mexican prospector would fail to find if he should try; and if it were exposed, the chances are that he would find and try it.

In outfitting to go to Mexico, one should know some time beforehand so that he may buy and use the articles a little while at home, for it is much less difficult to pass the Mexican custom officers with a set of things which are somewhat worn than with a new outfit. Shoes and clothing are especially high in Mexico, and in selecting these one must have not only an outfit for rough work in the hills, but also for town and social wear, as in learning the language the social side of life in Mexico is not to be despised by the prospective prospector.

For working clothes, I have found brown cotton-duck of close texture and light weight the most serviceable. For town use, one-half dozen or more suits of white linen or crash will be found serviceable

for summer, while for winter wear, ordinary woolen clothes are good. In providing foot-wear, one should remember that Mexico is a stony country, and about twice the ordinary amount will be required. If one has any knack for tinkering, a small shoe-repair outfit will be found very useful, as the Mexican cobbler is a brigand in disguise. One should take a riding outfit—saddle, bridle, spurs, and saddlebags. Not that any money will be saved in this way, for it is nearly impossible to get these things through the custom house without paying an exorbitant duty; but all leather manufactured in Mexico is villainous, and the satisfaction of a good outfit when you are nearly living in the saddle will more than compensate for any added cost. Blankets, and all kinds of bedding, are scarce, poor, and dear. One should take at least two pairs of ten-pound California blankets, or other bedding of equal warmth, and an 8 by 10 A tent of 8 or 10 ounce duck, made with a flap at both ends so it will open out flat.

A rifle and shotgun will be found useful, as there is large and small game throughout Mexico. Take plenty of ammunition for each, as that comes high, and there is not a good assortment for sale. A small medicine case will be of value. It should be stocked as much as possible with drugs in dry state and a few simple surgical appliances. Tobacco for smoking is very cheap in Mexico, but American chewing tobacco is very dear. Whether one is a chewer or not, it is advisable to take all that can probably be taken through the custom-house (five or six pounds) as a speculation, if not for personal use. Cooking utensils are to be had at a price that makes it not worth while carrying them along. But if I were going again, I should take along a small, but durable, camp-stove with an oven. Bread is not to be had outside of the larger villages, and one gets exceedingly tired of the *"tortilla"* and camp-fire "flap-jack." If he who is going is a technical graduate, he should take along a very small blow-pipe outfit. More than this it is not worth while to carry, as there are assay offices in many of the small native mining camps, and the proprietors of these are always exceedingly courteous in extending the customary privileges to fellows of the craft.

In completing that portion of your outfit which you take from home, remember that the many little incidentals to which we are accustomed are used in Mexico by foreigners only, and are accordingly high, as Mexican political economy accomplishes in a measure what is unsuccessfully attempted by American protectionists, i. e., to make the foreigner pay. It is not feasible for a private individual to have anything sent by mail or express into Mexico. The charges for red tape

are ruinous if the article ever reaches its destination, and it is not likely to do so if it happens to excite the cupidity of any of the inspectors through whose hands it passes.

The first *thing* one meets on crossing the border into Mexico is a customs officer. In dealing with these, one should not pretend to be at all "fly." Be modest, quiet, and perfectly frank; open your packages without any hesitation, and do not molest nor bother the officer in his inspection. If you do this, he will probably be very superficial in his search. But he is naturally suspicious, and any subtilty, hesitation, or fussiness on your part will lead him to a very thorough inspection. Above all, be pleasant and courteous, for these qualities count for much in dealing with the Mexican. With whatever success one passes the border, he may be glad when he has passed, as he will there have come in contact with the most villainous class of Mexicans. The Mexican, like all other races, develops an additional rascality on contact with the Anglo-Saxon. But let the traveler not congratulate himself that he is clear of the customs when he is safely across the border. Mexico has not only national and State customs, but district and village customs, so that at every turn one meets with the ubiquitous customs officer. They even board the trains at way stations, and attempt to extort from such passengers as look "green" and "easy."

The first thing to be done on arriving at the locality wherein you wish to prospect is to learn a little of the language. It is well to secure work in some mine or metallurgical plant while doing this. But if you cannot get work, try to find a village where there are none of your countrymen, and secure board there. When you have acquired sufficient of the language to make yourself understood, and to understand short sentences, you will be able to make your way in a prospecting expedition. The best time to start out is in the early autumn, as the season of extreme heat, rains, and floods is then past, and you have three months of good grass and water ahead before the height of the dry season.

The points of the most vital importance in the outfitting are good pack and saddle animals. It is much better policy to buy animals than to attempt to rent them. The rates of rental are high, and the animals are invariably bad. Around the villages is a poor place to secure animals. The better way is to go to a horse ranch owned by some responsible Mexican, and there select and buy your animals. In doing this, there are many things to be taken into consideration, some of which I will try to outline. It is best to get animals which have been born and raised in the mountains, as those raised in the river valleys are not

sure-footed, nor sufficiently tough in the legs and hoofs. In addition to the ordinary "points" too numerous to consider here, there is one thing for which a particular look-out should be kept. This is known as "stickfast" in English, and *"matado"* in Spanish. A saddle-gall is, in warm climates, very likely to work down and injure the periosteum of the vertebra; an indurated growth is then induced; the sore may almost, or quite, heal, when the animal is turned out to rest, but on starting him under the saddle again it immediately breaks out. It is surprising how many of the animals offered for sale are thus afflicted. Every animal should be subjected to a very strict digital examination along the vertebra, and if he shows the least sign of tenderness at any point, he should be rejected.

In selecting a burro, I prefer a "chunky" gelding from three to seven years of age. I would particularly avoid an animal with a large rough head,—a *"cabezon"* as the Mexicans call him; he is likely to be foolish, slow, awkward, and weak. In horses, I prefer the "rangy" ones, as a chunky horse seems to become lazy and spiritless in hot climates. Two burros will probably be needed, and they should not cost more than $12 each. A good saddle horse should not cost more than $45. (In this article I shall speak of Mexican money.)

In Mexico unbranded mature animals, and animals which have been "vented" by a second application of the original brand, are considered "mavericks," and become the property of whoever can get possession of and put his brand on them. It is customary in the transfer of animals for the vendor to vent the animal, and the purchaser to apply his own brand; but, as branding disables the animal for several days, and as a prospector is not likely to have a brand of his own, the best plan is to take a bill of sale when you buy an animal, *with a drawing of the brand.* Then the brand holds the animal the property of the owner of the iron by common law, and your bill of sale shows for your title.

As equipment, you will need bells, bell collars, hobbles, ropes, and packing apparatus. After you have secured your animals and arranged their equipment, supposing that you have brought your riding outfit, the next thing is to secure tools, camp utensils, and food. For mining tools there will be needed a poll pick, a short shovel, a gold pan, a couple of steel gads, and a mortar. An axe for wood-cutting is needed, and a hatchet to use in hacking around camp and sharpening pick and gads, while a machete or brush knife to carry on your saddle is worth its weight in—well, at least in silver, when traveling in a cactus country. A belt punch, some copper rivets, a small pair of pliers, and

plenty of buckskin or lace leather will come handy in repairing harness. It is not worth while to carry powder and drills, as they make great additional weight, and you will be doing more tramping than digging for the first two or three weeks. They can be had at any supply point, when you do find a place where you want to dig.

In selecting camp utensils, one must select as for any other camp-life, where transportation is by pack animal. One line that should not be neglected is canteens, as one frequently has to carry drinking water. In making up a grub outfit, individual taste must govern to a large extent; but I would suggest, do not hold the Mexican foods in too much aversion. Imported goods come high, and are not as good for that climate as the native product. One can sometimes get eggs, milk, cheese, and fresh vegetables at the ranches on the way, but it is not to be depended on. The money you expect to spend on the trip should all be carried in Mexican silver and copper. It is practically impossible to change American money in Mexican rural districts, and many of the natives will not receive Mexican national bank bills; a good supply of small change should be carried as the Mexican is prone to price things at three, six, and thirteen-cent rates.

Having now prepared your traveling outfit, the next question is, where are you going? You will probably, long ere you feel yourself prepared to start, have been accosted by numerous individuals who have mines more or less distant. The first proposition of one of these Mexican prospectors is, usually, that you grub-stake him; failing that that you go with him and look at the mine; failing that, that you loan him two dollars. Never grub-stake a Mexican. If you give it to him in cash, he will spend it on a glorious drunk before he leaves town; if you give him provisions, he will take them out to the mine—if there is one; if not, to any suitable point, and assemble his friends and relatives and proceed to a protracted picnic. If there be any of the assembly who do not feel themselves up to the mark as vocalists or dancers, they may go out and dig for an hour or so, occasionally; but on the whole there will be very little work done for the amount of grub eaten. Never let one of these *"coyote"* miners undertake to pilot you to his mine, or anywhere else. He will have a number of ranchers of his own feather along the route of travel, with whom he has a definite understanding. He will pilot you to them for entertainment, and they will charge you outrageous prices for most villainous accommodations. In return for this favor, the rancher keeps the *coyote* whenever his wanderings bring him that way. Never loan money to one of these *coyotes;* it will not even have the effect of getting you rid of him—he will

come back to borrow more as long as he thinks there is a chance of getting it.

Do not be excited about any of the stories they tell you; the lower-class Mexican is a cheerful liar, preferring prevarication when truth would better serve his purpose, and the mining business is his particular field of mendacity; listen courteously to his yarns, if you have time to spare; then tell him that you expect soon to be traveling in the vicinity of his property and will take great pleasure in inspecting it. In the meantime, inquire among your Mexican friends as regards his character, and how big a liar he is.

A very profitable side-occupation, while learning Spanish, will be the drawing of a map of the district through which you expect to travel. Aggregate information from such maps as you can get, and from the conversation of such people as you may consider reliable. Pay considerable attention to trails, natural obstacles, distances, and watering places. Now mark the location of such of these *coyote* mines as you think worth visiting, on your map. When you start out in the hills, you will do well to spend a few weeks looking at these prospects. It is altogether possible that you will find some of them making such a showing that you will see fit to stop and put in some work on it. In case you do, do not go into any sort of partnership with the Mexican owner. Make your deal to buy out all his right and title. If nothing is shown to you that attracts you, you have at least the benefit of observing the formation of the country at some other person's expense of digging.

In traveling it is a good plan to go early and late, and rest in the middle of the day; arrange to pass watering places about two hours before time to camp. Stop only to water your stock and fill your canteens, then go on and make your camp where there is pasture for your stock, which will not be the case anywhere within six or seven miles of a watering place. On the first night out, and whenever camping within thirty miles of where your stock was raised, all stock should be picketed; at other times the burros may be turned loose with hobbles and bells; your saddle animal should always be picketed, as a horse or mule never gets the knack of shortstepping and traveling easily with the hobbles on as does a burro, but goes jumping and stumbling, thus spraining and bruising himself so that he shortly loses his sureness of foot when under saddle.

In making camp, it is necessary to place your meat where the coyotes cannot get it—either under the head of your bed, or better, hung up in a bush. A coyote once stole a sack of dried meat from under my

head when I was asleep, and I had not been looking on the wine cup either. One has need of a watch-dog. For this reason, and to assist in driving the burros, I think a shepherd dog would be found well worth his keep to a prospector. If you have a Mexican boy, you must nevertheless see that everything is properly attended to; the Mexican is not to be trusted with any responsibility.

In traveling through the country, you will at first have considerable difficulty in finding the way; the roads are mere trails, and are likely to be joined and crossed by numerous stock paths, which are better beaten than the road itself. The ignorant Mexican is very poor at directing one; he has only the most rudimentary ideas of distance. A place to which he is accustomed to make frequent trips, stands in his mind as *"cerquita"* (near), while an unknown locality is *"lejos"* (distant), though the actual distance may be less in the latter case. Another thing that will complicate your difficulties is the fact that the accent and dialect will change with every fifty or sixty miles you travel. Above everything, do not attempt to use any word of English in conversing with one of these ignorant natives; if you are unable to call up a word you wish to use, you may make signs, or leave it out, and he may infer your meaning, but the substitution of a single English word in a sentence will put him in a state of mental stampede.

When traveling with pack animals, it is very necessary to arrange your camping places so that you will not have to make an extra long day's march. About ten leagues (thirty miles) is proper for a loaded burro. You may divide this up as you like, either early and late, or a regular work day, or, as is frequently done in the hot season, make the whole march after night. If your burros are good ones, they will make the ten leagues, with a short rest in the middle, and act in a very decent manner; but after that distance they develop an ingenuity for "cussedness" that is remarkable. They will run off the trail, catch their packs under every low limb, get packs and saddles disarranged, and be altogether incorrigible. As the driver under these conditions will be tired and angry, he is likely to fail to give proper attention to the saddle padding, with the result that the animal will acquire a sore back, thus making trouble for months to come. In case an open abrasion does appear on the animal it should be protected by a coat of tar when not covered, as it is liable, especially in hot weather, to become infested with maggots, thus necessitating an application of quick lime and insuring a bad scar, if not formation of fistula. Yellow gnats will prove a continual pest to the eyes of the animals, particularly the horse; they cause a mucous discharge from the eye and keep up such

an irritation that the horse will keep his eyelids and cheeks raw by scratching. The best alleviation is a brow band, with pendants of cotton cord extending down over and below the eyes.

When you camp near a ranch house, you are likely to be visited by vaqueros wishing to show you mineral indications of which they know in the vicinity. These fellows are in the main honest, and do not expect any immediate reward except an occasional meal at your camp. If you have time—which should always be the case in Mexico—it will do no harm to go with them and look at their prospects; they are likely to over-estimate what they have, but you may depend on it that they have seen everything in the mineral line that is at surface in their locality. It will be well to question them as regards any ancient metallurgical ruins that may be in the locality, for the old native slag dumps and beds of arrastra tailings are some of the best things to be found in Mexico. Right here it will be well to mention an error into which many prospectors fall. On finding one of these ancient metallurgical plants, they argue that there must necessarily have been a rich mine in the immediate vicinity to furnish ore for such extensive operations. This theory looks plausible, and is supported by the numerous vague stories of the natives about rich mines that were buried up and concealed by the missionary "*padres*" at the time they were divested by the Government of their absolute authority in that region. Much time and money is thus spent in looking for the mine, when, as a matter of fact, the metallurgical plant had its location by reason of proximity to water, fuel, or the mission, the ore having been brought from dozens of little mines at various localities many leagues apart.

If, after visiting numerous *coyote* mines, you decide that none of them is worth your attention, it will be in order for you to find a region wherein to prospect yourself. In doing this, it is not well to put too much credence in native rumors. The Mexican has the faculty of investing every inaccessible locality with great mineral possibilities—as, for instance, the case of the Bacatete mountains in the Yaqui Indian reservation in southwestern Sonora. This range has been closed to exploration for many years on account of Indian hostilities. The result is that the most fabulous stories are current in Sonora of the mineral wealth of the Bacatete range. On the strength of these stories I once seized upon the opportunity, when the Indians were in a comparatively peaceful state, to spend a month prospecting in this range. I traveled from one end to the other of it, finding the country composed of the volcanic rock known locally as *malpais*, and utterly without visible mineral indications.

When, after giving these matters due consideration, you have selected a locality in which you desire to prospect, it is well to find a point as near to water as it is possible to find pasture for your stock, and there establish a camp. From this you can radiate until you have prospected a territory three or four miles in radius. If it comes convenient, it is well to ask permission of the rancher on whose land you are prospecting; he will rarely, if ever, fail to give it, and the courtesy serves to establish the *entente cordial* for further relations. He will also inform you if any one has a "*zona*" (a sort of mineral option to be later explained) on the land where you are working, in which case you will wish to leave it.

Many writers of more or less practical knowledge have attempted to give directions for prospecting. They have probably done it as well as possible, and as their works are available to every one I shall not make much attempt to enlarge on this subject. Successful prospecting seems to be more a matter of chance and the semi-instinctive knowledge acquired by experience than of science. Scientific knowedge has its legitimate place in the business, and should not be by any means underrated. I should place a natural tendency for close observations and logical deductions therefrom as of equal value, while a combination of the two is a qualification unexcelled for the man starting into this line.

The conditions of "rock hunting" are not very different in Mexico from those in any locality, except that in the mountainous districts the soil is thin or absent and the vegetation sparse and scattered. This, of course, greatly facilitates the work. My favorite method is to work up the beds of the water-courses looking for mineralized float. Failing to find it there, I go along the hillside about half-way up, turning over and breaking any promising bit of rock; failing there, I work along the crest where the rock is in place; if none of these localities show any mineral indication, I pass on. If a piece of mineralized float is found, the amount and character of the attrition considered in connection with the lie of the country will give evidence of how far it has traveled, and whether by water or by gravity. The comparative amount of oxidation on the surface and interior of the fragment will give indication of the time since it was fractured from the ledge. In reaching conclusions, one should ever bear in mind the possibility of ungeological causes, as the dropping of ore from a pack train.

If you find anything, it is advisable to keep silence about it, and even cover up your work until you have taken the first of the legal steps to be hereinafter described. There is not the same sense of

honor about "jumping" in Mexico as in the United States. The first legal step, the *zona,* is in effect an exclusive option to locate mineral within a certain area, usually about 1,000 metres radius within a given length of time (90 days); it is renewable once. The expense of securing it is about $15. No survey is needed, but you must have a care that the description of it is reasonably definite, and that you apply for it at the capital of the district where it is located. The word of the officers in the office of record is not to be relied on for this, as they are likely to record and give a *zona* anywhere, if there is a fee in sight. The ranch people around where you are prospecting can tell you in what district you are working. Having taken out your *zona,* you may now go ahead and work openly on your prospect, without fear of jumpers. It will be well to follow your vein to at least thirty feet of depth before going to any additional expense. There are a surprisingly large number of veins in Sonora, particularly those carrying copper, which appear to be just the bottom of an ancient fissure vein, the upper part having been eroded. On following them to a slight depth, they utterly pinch out, leaving not the slightest leader to follow.

I once found a vein of this kind which consisted of about an inch of nearly pure chalcocite, carrying 62 per cent. copper and nearly 100 ounces of silver. This was flanked on either side by about six inches of oxidized material carrying about 20 per cent. copper and 10 ounces of silver. The ground was covered by a *zona,* held by some parties who were prospecting an adjacent vein. I covered my work, and waited for the expiration of the *zona,* when I started back, considering my fortune made. I found that my predecessors had discovered my prospect and had dug down about sixteen inches, with the result of digging out every trace of a vein. I afterwards learned that they had found outcroppings of the same vein at different places along a distance of about two thousand feet, and had sunk several times with the same result. I have seen practically the same thing occur a number of times on work done by my friends in Mexico. Hence, I advise a considerable development of the vein before any great expense is incurred.

In carrying on your work, it may be necessary to hire Mexicans, and you will find them fairly worth their wages as miners, so long as you stay right with them and set them a good example. It will be advisable to get a supply of "grub," cigarettes, and other Mexican necessities, and sell to them as they earn wages. You can charge a good big profit, and can practically pay in supplies. But never let them draw much in advance; better not at all.

If, at the expiration of your *zona* you conclude that you want the ground, you must then "denounce"; this consists of a formal declaration that you have found metalliferous mineral in paying quantities at a certain place. This must be filed at the mineral capital of the district. The cost of this is $25, and in making it, you may ask for and receive as many *"pertinencias"* as you like. A *pertinencia* is the mineral right to 100 metres square of land without extralateral rights. It carries with it surface rights to sufficient land for the erection of the necessary machinery. Any further surface rights must be bought from the owner of the ranch. If he is obstinate, you may have the land condemned and appraised by law. The *"denunciamento"* must be followed within sixty days by a survey made by the mineral surveyor of the district. There is no regular fee for this; it is to be settled by a bargain between the surveyor and yourself. After the survey is made, the papers are sent to the City of Mexico, and in due time the title will return without further cost except the revenue stamps. After this, you must pay an annual tax of $10 per *pertinencia* for gold and silver claims, and $2.50 for copper. A failure to pay this forfeits all rights. No assessment work is required. This is the process of obtaining title to metalliferous mineral veins.

As regards placers, I am not posted. Old beds of arrastra tailings, old slag dumps, and coal, belong to the man holding the surface right, and must be bought of him. On all gold and silver mined in Mexico, a mintage charge of 10 per cent. is made, whether it is minted there or exported in the ore.

Finally, in carrying on any kind of mining or metallurgical operation in Mexico, it is necessary to exercise great caution against theft of rich ore or mill products by the employees. Popular opinion holds that the mineral riches of the earth are for whoever can lay hands on them. I am sorry to say that this theory permeates the Anglo-Saxon mind on long residence in the country. The greater intelligence and daring of the Anglo-Saxon has given him a reputation in villainy, embodied in the Mexican proverb: *"No hay otro coyote como un gringo sin vergüenza"*—"There is no rascal like a shameless Yankee."

EDITORIAL COMMENT

THE condition of the suspension bridge between New York and Brooklyn is a matter of most material importance to those cities—indeed, of very vital importance to many of the inhabitants; but beyond all that it has a strong popular interest reflecting the feeling displayed by every writer who has ever discussed great bridges and bridge building in THE ENGINEERING MAGAZINE. The late Mr. T. C. Clarke, Mr. Gustav Lindenthal, Mr. Albert W. Buel, Mr. E. C. Gardner—each primarily concerned with a very different aspect of bridge construction—all find themselves to some degree inspired by the picturesque, it might almost be said the romantic, atmosphere surrounding a great structure of this sort. This appeal to the imagination heightens the interest which would in any case attach to the report of the experts appointed to examine the Brooklyn Bridge.

It is unfortunate that this report should be made public at a time when it will inevitably be regarded by many as a political weapon aimed at the local administration. No one will for a moment suspect the engineers who framed it of any political bias, even the slightest, but the fact that the officials to whom the report was presented have selected the height of an active and heated campaign as the moment for its broadcast publication will almost inevitably detract from its effectiveness as a painstaking, serious, and very important professional opinion.

The most immediately striking elements of the report are the statements of overload which are made without qualification. Working stresses of 71,000 pounds per square inch in the main cables, exclusive of any additions arising from wind pressure, are extremely high. At least as much must be said of the calculated pressures in the tower masonry—39.6 tons per square foot. And the stresses in the floor members are correspondingly higher than safe practice would contemplate—27,000 pounds per square inch in intermediate floor beams of railway tracks, 25,000 pounds per square inch in intermediate floor beams of roadway, 34,000 pounds per square inch in some of the channels, 17,000 pounds per square inch in others—all against a permissible working stress of 14,000 pounds per square inch. Many of these conditions could be referred only to defects of design. Throughout, the engineers have confined themselves to stresses of considerable size, which can be calculated with substantial accuracy from the data available, but there is a certain element of ambiguity arising from the impossibility of securing all the needful data.

Herein lies the second most startling development of the investigation. Of a great and important bridge, carrying probably the greatest daily traffic of any similar structure in the world, which has repeatedly been the subject of expert examinations, which has for years been under the charge of highly salaried and supposedly competent officials, the committee of inspection is forced to say: "The lack of adequate plans of the bridge is such that a complete survey of the structure would be necessary in order to obtain a full and reliable knowledge of its members."

The remaining development of im-

portance is almost matter-of-course to anyone familiar with existing methods in New York City political departments. It is merely the exposure of gross negligence and indifference in the inspection and care of the structure. It is recommended to those who are ardent for municipal ownership and operation of public utilities.

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THE result of the Cup races evidenced in the most conclusive manner possible the almost marvellous *rapprochement* of naval architecture and what might be called "sailing-machine design," at least as between England and the United States. Considering sailing time as the measure of efficiency, the difference between two structures, built three thousand miles apart, was hardly ever as high as one per cent, and in the last race was scarcely more than four-tenths of one per cent., reckoning in the time allowance, and almost too small for expression by figures, reckoning boat for boat. When the comparison comes as close as that the most minute conditions may determine failure or success. And, in the view of wholly disinterested authorities well qualified to judge, the structural and tactical handicap imposed by the condition that the challenger must cross the ocean under her own sail, while the defender need not, is much more than a trifle. It was prescribed when the contesting yachts were merely very finely modelled examples of the yacht building of their time—cruising boats, like others of their class except for superior excellence of design and finish. Now that the contestants have become a class by themselves, practically serviceable for no other function, it would be a matter of great satisfaction to many sportsmen and students of marine construction everywhere if every possible artificial handicap or advantage could be removed and the absolutely equal test of boat building and boat sailing be divested of every other disturbing condition.

HERR LÜDERS, in the conclusion of his most instructive review of Machine-Shop Practice from a German View-Point, which appears elsewhere in this number, speaks of the accounting and cost-keeping system as the "real soul of every works." It is perhaps not easy to find a physical or a psychical analogue for the cost-keeping department, but it is certain that many and many an undertaking goes to destruction for lack of it, or for lack of intelligent reliance upon it. It is the steady monitor of business conditions, the unfailing adviser and guide in commercial transactions, the unerring balance by which to weigh the profit of routine or extraordinary ventures, the check and corrective of over-confident enthusiasm.

And it is remarkable to see how widespread is the recognition of the essentiality of a sufficient cost-keeping system in the works, and how close is the study managers everywhere are putting upon the problem of cost-keeping principles and their application.

An interesting and important department of our editorial mail is forming from the many inquiries touching adaptation of methods described in the Magazine to conditions arising in particular lines of business, or suggestions carrying to further extension the basal principles laid down by such authorities as Mr. A. Hamilton Church, whose comprehensive discussion will close in our next issue. And in such inquiries and comments often lies the suggestion of important new ideas awaiting development by the new applied science of cost-keeping—a science whose literature is now in process of making.

* * *

WITHIN certain limits the "official" fetish has been regarded with less awe in the United States than in almost any other country, while at the same time there is hardly any country in which official utterances and publications have been more generally received as authoritative and employed by civilians

with confidence. Especially has this been true of the publications of the War and Navy Departments. In England especially has favourable comment been made on the freedom with which important Government bureaus in America have published information which would have been most carefully secreted from the profanation of public gaze at Whitehall, and the reports of the Bureau of Steam Engineering, of the Ordnance Bureau, and the Bureau of Construction and Repair, for example, have been accorded even more consideration as scientific professional papers than the transactions of the great national societies.

We are now, however, beginning to feel that some of this confidence may have been misplaced, for when, as in a notable, or perhaps notorious, naval inquiry recently at Washington, we find that official maps, endorsed as correct by high officials, and given to the public with the authority of the Navy Department, are thrown out of court as confessedly worthless on the testimony of those who assisted in making them, we wonder how much more of this sort of thing has been going on.

Not only maps, but official logs of battleships and cruisers have been admitted to be garbled and incomplete by those whose duty it was to see that they were kept scrupulously correct, entries of vital importance having been omitted at the will or whim of responsible officers.

The most discouraging thing about all these revelations lies in the apparent indifference with which they have been regarded by officialdom in general. No attempt has yet been made to explain that these glaring examples of misinformation are exceptions or accidents. On the contrary there has been a disposition to pass them over as immaterial or unimportant. They cannot be so regarded by the engineering profession at large, and unless something is done to restore the confidence which has been disturbed by these revelations the official records of the Navy Department of the United States may soon be ranked with the bordereau of Esterhazy, and banished from the shelves of civilian engineers as no longer worthy of confidence or respect.

Another noteworthy circumstance is the official confirmation of the startling disclosures made by Mr. Arthur Warren in THE ENGINEERING MAGAZINE for January, 1899, of the unreadiness of some of the ships, under the command of deck officers. An instance is the proof from the steam log of the Brooklyn that she had her forward engines uncoupled, banked fires under three boilers, and others filled with cold water or empty and fires not even laid. Thus what the line officers heatedly characterised as the charges of a civilian prove to be officially recorded facts.

* * *

THROUGH an inadvertence of statement in the article on "Mechanical and Electrical Features of the Buffalo Exposition," which appeared in our September issue, the multi-voltage system of power distribution was made to appear as an exclusive or peculiar feature of the practice of the Bullock Electric Manufacturing Company. The phrasing was changed in the last proof submitted to the editorial office, but the correction was overlooked by the printers, and so the printed page contained the paragraph with the faulty reading attributing the system to the Bullock Company as originators, instead of the intended one stating that the system was exhibited by them at Buffalo. As a matter of fact, this system has received special attention from the Crocker-Wheeler Company, and one of the first establishments to be successfully equipped with the system was that of Sir Joseph Causton and Sons, at Leeds, where the Crocker-Wheeler Company put in some seventy odd motors on multiple-voltage system some three years ago.

REVIEW OF THE BRITISH PRESS

Improved Workshop Methods.

The subject of works management is one to which this magazine has given much attention, and hence we are gratified to observe the extent to which its lead has been taken in papers and discussions elsewhere. Three papers at the Glasgow meeting of the Institution of Mechanical Engineers treated of various phases of the subject, including the remuneration of labour, the economical manufacture of marine engines, and general workshop methods. The paper upon the last subject, contributed by Messrs. William Weir and J. R. Richmond, contains some especially interesting features, giving details of the working and general results of the premium system, a foreman's club, a suggestion scheme for improvements, a technical committee for dealing with new designs, and an intelligence department, for the collection of data on various subjects relating to the work of the establishment.

The premium system has been fully discussed in the pages of this magazine, and the suggestion scheme is practically in line with what has already been so admirably carried out at the works of the National Cash Register Co., at Dayton, Ohio, and elsewhere, but some of the other features are most interesting.

"To secure a proper discussion on shop problems, and to provide machinery for the systematic carrying out of suggestions and reporting of results, it was decided to inaugurate a club composed not only of foremen, but of all the administrative heads of departments, drawing-office, costing department, correspondence department, &c.

"When the club was first proposed, its reception was not at all favorable; it was considered by the foremen that the discussions would breed dissension, that reflections would be made by one foreman on the work of another, and that generally it would give rise to internal friction. It was accordingly named the "Friction Club," on the principle that its mission was to be the elimination of friction. Its business was to discuss shop problems and decide on solutions, to institute improvements and provide the means of carrying them out to finality; to receive and adjudicate on complaints and suggestions. Its rules were made as elastic as possible. Its office-bearers consist of an executive committee of five, three chairmen, who preside in succession, and two joint secretaries. Meetings are held once a month, in the evening; the proceedings are reported and copies are neostyled and given to each member, for insertion in a spring binder with which he is provided. The business of each meeting is arranged by the executive, and deals with whatever shop questions are most pressing.

"A club letter-box is provided in the shop, into which members are requested to send notes on suggestions or subjects for discussion. This box is opened by the executive committee prior to the issue of the notice for the following meeting, and if any matter requiring discussion is received in the box, it is incorporated in the business for that meeting.

The club was started at first with some misgivings, but it has steadily improved, and has taken its place as a most helpful factor in the establishment.

Among the matters dealt with by the club have been the following:

1. The establishment of a works library, containing books and current technical papers and magazines. The weekly technical papers are available for members of the club one week after publication, the monthly magazines one fortnight. Books can be borrowed at certain hours from the library, and the private technical libraries of members of the firm are made available to members on application. (2) The workmen's suggestion scheme, as described later in the present paper; (3) the admittance and course of apprentices in the works; (4) the

lighting of the shops; (5) the arrangement of the firm's exhibit at the Glasgow International Exhibition; (6) the distribution of shop labourers; (7) shop hindrances—a report by each foreman on his department, indicating the hindrances interfering with the execution or output of the work of his department; (8) grindstones *versus* emery wheels; (9) wearing of overalls, etc.

The decisions of the club are, where necessary, submitted to the directors, and receive their sanction before being put in operation; but as each of the three chairmen of the club is a director, this is usually a matter of form.

The other feature in the paper to which especial attention is directed is the "intelligence department." This department deals with the collection of information and data required by the various departments and members of the firm; the indexing, cataloguing, and filing of technical literature, catalogues, cuttings, &c. It secures a systematic perusal of contract advertisements in the technical papers, marks and records openings for the firm's products, and keeps a card index of parties interested or likely to be interested in them. The principals or heads of departments furnish notes of special subjects on which they desire information, and articles in current magazines or papers are marked for their perusal. When the subject is a general or voluminous one, such as water-tube boilers, Romeike and Curtis can be requisitioned. The technical index of the "Engineering Magazine" is also utilised, and special articles are obtained by coupon when required. These cuttings are filed under department or subject heads in cardboard cases for reference.

Suppose the firm is considering any problem, say foundry equipment, the intelligence department is requested to collect the articles dealing with the subject; the various yearly indexes of technical papers are gone over; and, if need be, a summary is prepared for the technical committee, or the individual member to whom the question has been remitted. This method saves the time of the more expensive staff, and is a means of readily obtaining concentrated information with a minimum expenditure of high-paid labour.

If competitive business is considered as commercial warfare, such an intelligence bureau may be compared with the departments of official information by nearly all governments in order to enable them to be kept abreast with possible rivals. Such an office, properly maintained and actively used should conduce to great economy by avoiding duplication of effort, saving the results of costly experiments already undertaken by others, and the maintenance of a general state of readiness to receive whatever is new and valuable, or to reject whatever may be old or worthless.

That such organised measures should not only be advocated, but already adopted, is welcome evidence of the progress which is being made in workshop administration, progress which cannot but work to the benefit of employers, employed, and customers.

Recent Developments in Locomotion.

THE Presidential Address of Col. R. E. Crompton, before the Mechanical Science Section of the British Association contains an interesting discussion of some of the recent developments of locomotion on land which, as he well says, demand the best thoughts, not only of engineers, but or every one interested in means of travelling and in the more rapid transit of goods.

Reviewing the development of railways during the past seventy years, it appears that, apart from a certain limited number of very high-speed trains, the general speed limit of railways of the present system of constuction is about 65 to 70 miles per hour.

"Higher speed on level runs has undoubtedly been recorded, but it is not probable that anything greatly in excess of 70 miles per hour will be reached until our railway managers initiate an entirely new system of construction. The high-speed service that is now in contemplation, not only in England but in America and Germany, intends to attain speeds of over 100 miles per hour by providing electrical means of haulage sufficient to propel light trains consisting of one, or, at the most a few cars; and in order to render this service successful, to run these light trains at short intervals of time, so in effecting this high speed the railways will give a service which more nearly resembles the tramway service than our pres-

ent system of heavy express trains at infrequent intervals. This high-speed service of light trains at frequent intervals is well suited to electrical haulage, as it works generating machinery situated at fixed points to the best advantage and enables the best return to be obtained from the necessarily heavy capital cost of copper in the conductors which transmit the energy along the length of the line, as it is evident that if the speed be sufficient to insure that each section of the line only carries one running train, the costs of the conductors will be in proportion to the weight of that train."

Very high speeds, however, can only be used to advantages in cases where the journeys are of sufficient length to make it profitable, and hence this topographical question must naturally place Great Britain at a disadvantage with the Continent and with the United States in respect to high speed systems.

Passing, then, the subject of high speed, Col. Crompton proceeds to consider a most important problem in locomotion, viz., that caused bv the congestion of street traffic in our towns, and by the undoubted difficulties which exist in carrying our workers to and from thier homes in the country to their places of employment in our towns.

"A large proportion of the workers who, during the latter half of the last century lived and worked in the country, are now working in towns, although some of them still live outside in order to obtain the advantages of lower rents and of a healthier life for their families, and this last class is likely to largely increase. Those who have been responsible for the enlarging and improvements of our towns have done so much to make town life preferable to country life, that the country is gradually being depopulated. The results we see in the increasing difficulties which the town authorities find in dealing with the water and sewerage questions, and in the increasing mass of vehicular street traffic, which makes some of our cities veritable pandemoniums."

This matter can be helped only in a minor degree by the introduction of tramways, and indeed tramways to a large degree aid in increasing the congestion. In many instances the tramway occupies a portion of a road already too narrow for the demands upon its capacity, while at the same time developing an increase in local population causing still further congestion.

The remedy has been suggested to lie in the use of independent motor vehicles, but these cannot be operated to advantage on existing roads, or indeed on any roads already congested with local traffic. Motor vehicles demand improved roads, and furthermore they demand new roads.

"The increased road and street traffic, and the development of new means of road locomotion, have made imperative some modification of our existing system of roadway administration. Cycles, motor cars, and electrical tramcars have been invented and put on the roads which are maintained and worked exactly as they were seventy years ago at the commencement of the railway era, when the population of the United Kingdom was half its present figure, and that of the large towns one-tenth of the present figure. During the 150 years previous to the railway era the ancient tracks were gradually improved into tolerably efficient roads for coach and wagon traffic; but after the introduction of railways there was a complete cessation of improvement, as for 50 years after the railways started the old roads were equal to the farmers' and local traffic which the railways left for them; but for the last 20 years the roads near to the great towns have been inadequate, and now that the cyclist and motorcarist travel over the whole of the roads of the country, the neglect of our ancient roadway system is very apparent.

"Although the urban populations have so greatly increased, the old coaching roads are still the only ones that exist; no main roads parallel to the old ones, or alternative to them, have ever been made. Towns which are now joined by railways grew out of small rows of houses built facing the main road; in fact, in many cases the road made the town. During the early part of the railway era, when the roads were so little used from coaching falling into disuse, encroachments on the roadway took place in and near the towns, such roads being now actually narrower and less suitable for traffic than in the coaching days; so that these towns which owe their existence to these roadways now put every impediment and hindrance to their use by the travelling public. What is needed is that towns situated

on our main through roads should provide alternative routes, so that through travellers could, if they desired, avoid the crowded streets of the town. One method of providing such relief roads would be by by-laws providing that all building estates should set aside land for main roads. The building estates which are developed around our great towns never provide a road which can be used as a main line of thoroughfare, although by their very act of building additional houses they cause additional congestion to the main roads. They lay out their roads to obtain quiet for those who live on the estate, and take every possible means to prevent their estate roads from taking a share of the main thoroughfare traffic."

Given, then, improved roads, together with especial highways for motor vehicles, permitting the rapid speeds of which they are capable, we have a solution of the problem of much of the congestion of the present day. The actual time of running may be slower than that of steam railway trains, but the independent vehicle, starting from one individual location and arriving at the other without change, will in many instances save time in the total length of the journey, while in most cases much will be added to the comfort of the traveller.

Col. Crompton closes his address with a discussion of the importance of standardisation in all departments of engineering work including motor vehicles, and speaks with especial commendation of the establishment of the National Physical Laboratory.

The Adoption of the Metric System.

WITH the increasing competition for trade in mechanical products with metric using countries there has come a demand for the introduction of the metric system in British workshops, in order that the demands from customers for articles in their own system of dimensions may be met. For this reason the paper of Mr. Arthur Greenwood, upon the adoption of the metric system in British workshops, presented before the Mechanical Section of the Glasgow Congress, demands attention at the present time.

Personally Mr. Greenwood maintains his own experience in international trade has caused him to believe that the adoption of the metric system would aid materially in pushing the sale of British machinery in foreign countries, and he goes so far as to advocate the adoption in England of the metric system in its entirety.

After referring to the many inconsistencies and difficulties of the English system, or lack of system, Mr. Greenwood admits that it is England's privilege, if she so desires, to continue methods which have been condemned by most nations of the earth.

"But," he proceeds, "it may be assumed that the British mechanical engineer cannot afford, and has no desire, to be content with any such position. He is determined to continue the efforts he has up to now successfully made, in spite of what has been lately said and written as to his decadence, to push his manufactures in every market in the world. He has to meet competitors from America, Germany, and France in the countries of Europe and elsewhere where the metric system is universal. Germany has followed the lead of the Latin countries, and has abolished her many standards of feet, and Austria has done the same. Russia continued to honour us for years by using our standards, and still does so to some extent, but in Russia before very long the metric system will be as general as it is in Germany, thanks very largely to German propaganda in that country. If the British mechanical engineer is to hold his own in these markets, it is imperative that he should offer goods to conform to their usages in dimensions and weight. The writer would appeal to those of his engineering colleagues who have doubtless found themselves in the same desperate position he has found himself, provided with a drawing of an elaborate machine carefully scaled to 1 in. or 1½ in. to 1 ft., and with probably a very imperfect knowledge of the language of the country with which he desires to transact business, and endeavouring to answer the numerous questions of an inquisitive and intellectual foreigner who wants to know the dimensions in millimetres and weight in kilograms of particular parts of the machine. Under such circumstances the wonder is that orders could be obtained at all, and considering the disadvantage under which he has shown his wares, success in obtaining orders can only be considered a tribute to excellence of de-

sign. True, experience has taught many engaged in Continental trade to have plans drawn to tenth scale, thus somewhat mitigating the difficulty here alluded to, but no one can possibly maintain that the seller's position would not have been wonderfully improved, and his own and his prospective purchaser's temper less sorely tried, had he been provided with drawings in metric scale, and with weights indicated in kilogrammes instead of tons and hundredweights."

Leaving aside the possibility of any change in the metric system at this late date, which might render its introduction easier, the principal objection to the change would be the cost. This, we think, is underrated by Mr. Greenwood, and the real question in that direction is the balancing of the actual cost of the change against the cost of not changing. That trade is lost by not conforming to the desires of metric using countries is doubtless true. This subject was agitated in America about a year ago in connection with the manufacture of screw-cutting lathes for export. It was found that some establishments provided such tools with metric lead-screws, but in most instances a translating change-gear was provided, and the same result accomplished at less cost. When it is understood that all over metric-using countries the Whitworth screw system, with English dimensions, is in general use, and that no one of the fifteen or twenty metric screw-thread systems has come into general use, the urgency of change in this direction may well be questioned.

In America, also, one of the leading firms of machine tool builders, many years ago decided to put this matter to a practical test by equipping one of its departments with metric scales and tools; and produced, and still produces, the articles there made entirely in metric dimensions. After more than forty years the result is that the system has not been extended to other departments, and there is no more consistent opponent of the metric system than this same establishment, although its products go to all parts of the world.

The fact is that no legislation can be introduced which will render the metric system acceptable to the English-speaking world, but at the same time there is little doubt that English and American engineers will gradually be compelled to adopt it, acceptable or no. This will take place by the pressure of trade and not by appeals or argument, and it is to the commercial, and not the sentimental demand that we must look for the change to come. As a matter of fact the engineer cares little about the absolute dimensions of a machine or structure, it is the relative dimensions and the fitness of the design which claim his interested attention. Apart from certain limited parts, those which the user may be called upon to reproduce or replace, and which can readily be made to suit the demand, the dimensions of the rest are immaterial, so long as there is sufficient strength, and excellence of proportion. The true advantage of a decimal system, metric or not, accrues to the designer and computer, and that is in no way due to the metric system, but is caused simply by the accident which gave us 10 as the base of our very imperfect system of arithmetical numeration. It is yet within the bounds of possibility that a notation as far superior to the present as the present was superior to the Roman may come into use, a notation which may render computations of overwhelming difficulty as simple as ordinary arithmetic, and with the fading of the decimal notation the metric system will disappear and be no more seen.

Recent Improvements in French Lighthouses.

THE well-known completeness of the French lighthouse service, and the promptness with which improvements are adopted, renders the French coast the best protected in Europe, and for this reason the paper of Baron Quinette de Rochemont, read before the Waterways and Maritime Works section of the Glasgow Congress doubtless represents the latest modern practice.

"One of the chief improvements has been the adoption of *feux éclairs*, or lightning lights. With this new device the maximum efficiency of the illuminating apparatus is obtained; whether the illuminant be oil or electricity, it has given rise to quite a series of new types of appliances used in connection therewith. Again, the luminous efficiency of the optical apparatus has been increased by improving the focal precision, and by keeping the characteristic or effective

divergence within narrow limits. The generating stations for electric lighthouses, built until quite recently on old-fashioned lines, have been brought up to date with all modern improvements. The adoption of incandescent burners for compressed gas or petroleum vapour has been a great step in advance. Not only has the intensity of the light been increased, but a light with a wick and ordinary mineral oil can now be made to burn continuously night and day for three months, with only occasional examination at long intervals of time. These permanent lights can have all the characteristics of superintended occulting or flashing lights. The adoption of permanent lights has enabled points of secondary importance to be lighted under economical conditions, and has thus efficiently filled a gap in the system of maritime illumination. Other permanent lights, in the form of illuminated buoys fed with oil-gas, have been adopted on an extensive scale, either to increase the protection at dangerous points and as substitutes for certain lightships, or for lighting winding and shifting channels; also for supplementing the indications afforded by leading lights or sector lights, or for pointing out the position of works in construction at the entrance of harbours."

The lightning flash system is usually employed with electric arc lamps of high power, and is used especially for lighthouses of the first order, and it has been so fully described, both in this magazine and elsewhere, that it need not be discussed at length here.

More recent is the application of incandescent mantles, heated by compressed gas or petroleum vapour.

"Incandescence with low-pressure gas only gives a comparatively feeble intrinsic brightness. Compressed gas must be used in order to obtain a greater intrinsic brightness than that afforded by the largest petroleum burners in use. With compressed gas, the quantity of gas supplied to the mantle, and the rate of combustion, vary in proportion to the pressure; whilst the dimensions of the incandescent light remain unaltered. The temperature of the mantle and its intrinsic brightness are therefore gradually increased. To overcome the objectionable condensation which occurs when coal gas is used, even at low pressures, the Pintsch gas, which is already in use for lighting buoys, has been adopted. This gas can bear a pressure of 10 or 12 kilogrammes (140 lb. to 168 lb.) without condensation, so that it can be stored in small portable reservoirs.

"The necessity of building works for supplying the oil gas has limited the application of incandescent gas lighting to a few important lights. The Lighthouse Department therefore has endeavoured, with success, to obtain the same advantages, for a slight outlay, by substituting petroleum vapour for incandescent lighting. The burners employed are all made on the same principle, but their arrangements differ slightly according to the type of lighting apparatus for which they are intended. This principle consists in injecting the liquid petroleum into a vaporizer, heated by the mantle; the vapour then passes into the Bunsen burner of the mantle, after mixing with the air required for combustion. In starting, the vaporiser is heated by a spirit flame to the required temperature.

"Incandescent gas lighting, when no special gas works are required, is not much more expensive than lighting with a three-wick burner; and even when special works are necessary it is more economical than a five-wick burner. The annual expenditure for gas lighting does not exceed 1800 francs (72*l.*) with gas works, or 800 francs (32*l.*) without works; for petroleum vapour lighting it amounts to 650 francs (26*l.*). These figures show at a glance the advantage, from an economical point of view, of the system of incandescent lighting."

High Speed Electric Traction in Germany.

Among the papers presented before the meeting of the Electrical Section of the Glasgow Congress, was an account of the experiment high-speed electric car which has been constructed by the Allgemeine Electricitäs Gesellschaft for operation at a speed of 200 kilometres per minute on the Berlin-Zossen military railway.

This paper, of which Herr Lasche gives an abstract in *Engineering*, contains an account of the trials which have been made on the testing stand at the factory, and it is expected from these that success will be attained in actual running on the road.

"The problem put before the designer was

the creation of something altogether new, namely, the construction of an experimental motor car, outside any existing type of low-speed electric locomotives, or of street railway cars. The only aim in view in making the investigations was the construction of a motor car to run long distances at the highest attainable speed.

"The weight of the electrical equipment in the first design was not less than 50 tons for the required output of 3,000 horse-power, but by modifying the construction of starting apparatus, motors, and transformers, the weight in subsequent designs was reduced to 30 tons. A large proportion of this weight was made up by the transformers, which may possibly be dispensed with altogether in the future.

"A question of the greatest importance was the mechanical connection betweeen the motors and the wheel axles. It was, of course, understood that all intermediate gearing was out of the question owing to its unavoidable wear and tear. Although from the beginning the object was to obtain an elastic connection between the motor and the axle, various designs and constructions were tried; in some the motors were rigidly coupled to the wheel axles, and in others a spring arrangement was provided. The solution of the problem of providing a spring device, to work at about 1,000 revolutions per minute and 750 horse-power per motor, was, of course, extremely difficult, and required a most serious and critical examination of the designs. The problem has been solved by a special arrangement, in which the power developed by the motor is transferred to the wheel by an elastic and sliding coupling, and by an elastic suspension of the motor, which from a soft movement in the beginning turns into a suspension of increasing rigidity. It followed from this arrangement that each motor must have a hollow shaft, and the speed in the bearings is nearly 15 metres (49 ft.) per second. A careful study of the friction at this speed has been made, and experiments also carried out with speeds up to 20 metres (82 ft.) and 25 metres (98 ft.), and with great bearing pressure

"Starting resistances for motors of 250 to 750 horse-power have already been used in practice; but the question of starting resistances for four 750 horse-power motors enclosed in a very narrow space, and for their continual regulation, had never before been contemplated. The individual merits of liquid and metal resistances were considered at length. The use of the former seemed to be out of the question, whereas the latter involve a great number of contacts, brushes, connecting cables, and resistance material, and were consequently too heavy and complicated.

"Four motors, each with three armature circuits, give a total of 12 phases, in each of which was inserted a resistance divided into 12 steps. Notwithstanding this subdivision of the resistances, the difference of the currents was still intense from step to step; and the regulation, done by jerks, was very unsatisfactory. The difficulty was overcome by the design of a patent starting resistance, such as can also be used for large winding engines.

"Although the resistance material here is a solution of soda, this apparatus has nothing in common with the ordinary liquid starting resistance—a fact which has been proved by trials made on a large scale."

The discussion brought out some very strong opinions as to the difference with which advance in electric traction was encouraged in England and Germany. In Germany the Emperor threw all his powerful influence to the development and advancement of the application of electric driving to high-speed traction, while in England, as in the case of the proposed Manchester-Liverpool line, opposition from authority was the order of the day. Ultimately it is to be hoped that broader views and greater encouragement to progress will prevail at home, but at present it appears as if the greatest hindrances to electrical development in Great Britain are found in her own officials whose methods of "how not to do it" have long outlived the attacks of Dickens.

The Commercial Organisation of Shipyards.

It is now generally recognized that there is no standard system of works organisation and management, but that different systems must of necessity be devised to meet the requirements of the many and varied kinds of establishments in operation. It is, however, possible to consider the general

principles which apply to works, of any given class, leaving minor details to be worked out in each instance as experience may indicate.

The paper by Mr. Walter Scott, recently presented before the North-End Coast Institution of Engineers and Shipbuilders, examines the general principles involved in the commercial organisation of shipyards, and gives some features which are of permanent value and interest.

Passing over the question of correspondence, which demands systematic and prompt attention, the questions of estimating and buying are taken up.

Estimating is a matter of much importance, especially when it is necessary to compete for work in the open market. To make a satisfactory estimate one must be able to form beforehand a close estimate of what the work will cost under normal conditions. With this as a basis, there is play for business abilities for judgment, or knowledge of the market and of the customer. A vessel is a large and complex structure, and a small error in estimating may amount to a large sum. In order to avoid the fruitful error of omitting something, printed estimating sheets should be used, with the details grouped so that the approximate cost of a vessel based on main headings may be quickly made up. This permits an estimate to be prepared promptly for a reply by the same day's post, or even by wire, without the risk of making some important omission, since any item missing on the sheet would at once be detected.

The question of buying is closely connected with that of estimating, since one must have a full knowledge of the current market prices of materials. Much material may be purchased on yearly, or half-yearly contracts, this applying especially to such stock supplies as paints, rivets, bolts and nuts, and the like. Materials such as steel, iron, and wood are generally purchased in quantities, and there is much scope for business acumen in arranging to contract ahead on a rising market to avoiding doing so when it is falling.

The matter of cost-keeping, as Mr. Scott observes, is of sufficient importance to demand an entire paper by itself, and can only be dealt with generally.

"All the costs should be kept in grouped detail, and arranged in precisely the same order as the estimate sheets; they must not on any account be allowed to run into ar rears. In a well organised office is should be possible to see the cost of any vessel to date at least each month, or even each fortnight, and that, too, at a period only two or three days after the date the cost is made up to. This is not a difficult matter, neither does it necessarilv involve a very large staff, whilst its importance is paramount both for estimating purposes and as a check on the cost of construction."

The important item of establishment charges Mr. Scott divides into two classes, the one covering the details of office expense, and the other the non-productive establishment charges, such as rent, rates, depreciation, upkeep, etc.

There are several methods of allocating the proportion fairly chargeable to each job; but the following is recommended:

Office expense, etc.—charged to each ship in proportion to the wages paid.

Rent, rates, etc.—in proportion to the tonnage of each vessel.

Depreciation—in proportion to wages paid.

Gas, oil, etc.—in proportion to wages, but corrected for the time of year.

Coal, etc.—in proportion to the number of tons of iron or steel worked into ship.

Smithy coal—in proportion to number of tons weight of smith work turned out.

All wages cost should be divided up so as to show the amount expended on any one job by each separate trade, piece-work and time-labour being kept separate. Returns of piece-work should be made every week, and the returns may be plotted to show a curve.

The object should be to enable the principal to keep in close touch, while at the same time avoiding too much centralisation, or he will be worried with details, and his time too much taken up to enable him to give the important points of the business the attention which it requires. At the same time close touch must be kept, or serious leakages will occur.

Alcohol Motors.

In view of the numerous questions which have arisen as to the advantageous use of alcohol in the arts, as an outlet for the increasing quantity manufactured, the exhaustive study of its use as a source of motive power, presented before the *Société de Ingénieure Civils de France* by M. Lucien Périssé, and published in the *Mémoires* of the Society is an important paper demanding examination and review.

Alcohol is especially a French product, and both at home and in the colonies it forms an important element in agricultural science. Recently the crisis in economics in certain agricultural districts in France, has rendered it most desirable that the engineer should come to the rescue by providing a suitable outlet for the product, and hence the paper of M. Périssé is especially timely and valuable. Ordinary ethylic alcohol produces 324.5 calories per kilogramme, and requires at least 7 kilogrammes of air for its combustion. When there is an excess of oxygen present, there is produced by the combustion only carbonic acid and vapour of water, but with a limited supply of air aldehyde is produced, this being then converted into acetic acid. This fact renders it desirable that an excess of oxygen should be present during combustion, in order that the formation of corrosive compounds may be prevented. The action of alcohol itself renders it necessary that carburetters be made of bronze and nickel, to the exclusion of iron and aluminum.

For practical use a 90 per cent. alcohol is readily available, and in order to avoid the possibility of its use as an intoxicant, it is subjected to a process of "denaturation," this being accomplished by the addition of methylene and heavy benzine. In order to increase the calorific power the alcohol may be carburetted by the addition of ordinary light benzine, from 25 to 50 per cent. of the latter being added. M. Périssé discusses at length the various methods of carburetting alcohol, giving a comparative table of different mixtures and their calorific values.

Passing over the legal questions examined by M. Périssé in connection with the use of alcohol in France, we proceed to its use in the generation of motive power. Like other light hydrocarbons is first vaporised in a so-called carburetter, and the vapor then used in some form of internal combustion motor.

Nearly all the engines in which alcohol is used are four-cycle motors of the Beau-de-Rochas type, although it has also been employed as a fuel for small steam motors, this application, however, being very limited. Generally speaking the use of alcohol as a source of power involves two distinct pieces of apparatus; the carburetter, or generator of the explosive mixture, and the transformer of energy, or motor properly so-called. Although both carburetters and motors have been given much study, especially in France, the peculiar requirements of alcohol as a fuel have not been given particular consideration, and the same is true of motors.

The function of the carburetter is the vaporisation of the fuel and its mixture with the proper proportion of air for the most effective combustion in the cylinder. Carburetters may be divided into four types: those which act by contact of the liquid fuel with heated surfaces; those which act by the pulverisation of the liquid in a current of air; those in which it is fed in small drops; and those in which the vaporisation is effected in a chamber heated by the explosions, this hot chamber serving also as a method of ignition.

In order that the alcohol shall be completely vapourised it should be heated to not less than 100°C., and this heat may be supplied in various ways. The most general system is that which employs the heat of the exhaust gases from the cylinder, either directly or partially, and in some cases the

waste heat from the ignition lamp is found sufficient. When the vaporisation is effected by a jet of air and an atomizer, the air is previously heated; heated air being also used when the fuel is supplied by a drop feed. When a heated combustion chamber forms a part of the motor, no heating is necessary in the carburetter, it only being necessary to insure a proper mingling of the fuel and the air. M. Périssé describes a number of carburetters of various designs, and calls attention to the importance of a correct regulation of the feed of the liquid fuel and the air. M. Périssé describes a designed for use with other liquid hydro carbons, and in practice those which act by pulverising the fuel in a jet of hot air, are found to give satisfactory results with alcohol. The feed is usually controlled by a float in an auxiliary reservoir.

In nearly all the experiments which have been made the motors used were originally intended for gas or gasoline, there having been but one alcohol motor shown at Vincennes in 1900. Data and results of a number of tests of such motors operated with various combinations of alcohol and benzine, are given by M. Périssé, showing that even with motors not especiallly proportioned for use with alcohol gave a thermal efficiency practically the same as with gasoline, so that the cost of power depends upon the commercial price of alcohol.

In designing a motor expressly for use with alcohol the principal points to be observed are that the stroke should be long and the compression high. The ordinary gas and petroleum engines are frequently made "square," as it is termed, the stroke and the bore of the cylinder being equal to each other. A more complete combustion, and a fuller utilisation of the effect of the explosion is obtained with a stroke of 1.75 to 2.2 times the bore. So far as the compression is concerned, it is a general law of internal combustion motors that the compression should vary inversely as the calorific power of the fuel. The exact degree of compression desirable for alcohol, or for mixtures of alcohol and gasoline, has not yet been accurately determined, but the advantages of high compression, both for economical working and for lowering the temperature of ignition have been plainly shown.

In view of the fact that a large part of the market price of alcohol is due to legislation and not to actual cost of manufacture, it is most desirable that with the technical development of its application to motive power there should be a scientific demonstration of the industrial advantages to be gained by directing this important product into a new field of consumption. This M. Périssé has done for France, and should the result prove of technical and commercial advantage there, other countries will not be slow to follow.

Power Development in Navigable Streams.

In the great majority of cases in which the power of a stream is utilised, a permanent dam is erected, and the entire flow is controlled for motive power. Many variable streams, however, are made navigable by the use of movable dams, and in such cases there is a greater or less quantity of hydraulic energy available, although this is usually permitted to run to waste.

At the dam at Poses, on the Seine, near Amfreville, in the Department of the Eure, however, there is an interesting combination of locks, movable dam, and power station, of which a description is given in a recent issue of *Le Génie Civil,* and from this some features of interest are abstracted.

The river Seine is divided at Poses into two branches, the main arm containing the movable dam, or barrage, while the narrow branch forms the navigable portion, containing the locks and a small needle weir. The normal difference in level at this point is 4.18 metres, or 13.71 feet, the flow varying from 100 metres at exertme low water to more than 1,800 metres in time of flood. The power thus varies from 0 to 22,000 horse power, with a mean development of about 13,255 horse power for about six months in the year.

The power house, which in this case is small, is placed on a pier between the two locks which occupy the small arm of the river, a most convenient location, as the masonry required is but little more than would be necessary for the pier, and the channel for the flow of water is the shortest and most direct possible.

As the power is at present used only for

the manipulation of the lock gates and the movable dam, a turbine of 30 h. p. has been found sufficiently large for the service, this being placed in a pit beneath the pier, leaving the main floor of the house for the elcctrical machinery. A pair of bevel gears transmit the power to a horizontal shaft from which the two dynamos, of the Gramme type are belted, these being of 40 amperes and 275 volts each. The general electrical details call for no especial mention, but the mechanism for the operation of the dam are of interest. The dam itself is of the Caméré type, with rolling curtains supported upon vertical frames hinged to a girder bridge above. The opening is obtained by first rolling up the curtains by winding up the chains passing beneath them and then lifting the frames by swinging them up upon their upper hinges.

As originally constructed, the winding of the curtains was effected by hand windlasses, this requiring four men to a windlass and necessitating arrangements for the men to go out upon the frames in midstream. These hand windlasses have been replaced by electrically operated machines, this enabling a prompt control to be obtained with a small number of operatives, two men, one upon each bank having entire control of the whole dam. When it is understood that the dam is 235.2 metres in length between abutments, and that there are 100 curtains, each curtain, with its chains, weighing 911 kilogrammes, it will be realised the magnitude of the operation. Although the speed of opening or closing is necessarily limited by the conditions of the flow of water in the river, a general gain in speed of more than 40 per cent. is secured by the use of electric power, and when it is considered that the energy is supplied entirely by the force of the river itself, the economy is apparent.

In addition to the suplpy of motive power for the manipulation of the dam, the power house furnishes current for lighting the works, this in itself contributing greatly to the convenient management of the plant. The total cost of the installation was less than 2 per cent. of the original cost of the dam, and would have been materially less had it been introduced at the time of the original construction of the works.

The employment of the force of a stream for the manipulation and control of its own regulating machinery possesses many advantages, especially for large installations, and notwithstanding the frequent and extensive variations in available head of water there is always power enough for practical service, especially when, as in the plant at Poses, there is installed an accumulator of sufficient size to equalise the loads. Although this plant is small, the excellent judgment which has been shown in its arrangement renders it especially worthy of mention and it will doubtless serve as a model for others.

Electric Plants in Germany.

It has been the practice of the *Elektrotechnische Zeitschrift* for a number of years to give an auual résumé of the statistics of electric generating stations in Germany, and these show in an interesting manner the development of electrical industry from year to year. Such statistics necessarily cover only public generating stations, it being impossible to secure data of the numerous isolated plants in operation; but the data of the public stations give an index to the growth of the electrical industry at large, and, when analysed, show the progress of various systems and methods.

At the present time there are in the German Empire 768 electric generating stations, of which 116 have been started since March 1900. In this number there are several groups of stations which are considered as single establishments, being operated in connection under the same control, the 768 stations representing 749 different localities. The data concerning all these stations are tabulated in such a manner as to show the system, magnitude, applications, and capitalisation, the whole forming a most complete exhibit of this important industry. For details the reader must be referred to these tabulated sheets, but some abstracts concerning the more important installations may be here given.

There are in Germany 33 cities of more than 100,000 population, and all of these, with one exception, possess electric generating stations, and in the city of Kiel, the exception referred to, a station is under construction and nearly completed. Considering the more important of these, classified according to the output of electrical en-

ergy, the largest are the two great stations in Berlin the Oberspree, which, with its substations, has an output of 22,075 kilowatts, and the Moabit, with 19,494 kilowatts, there being also five other stations in Berlin, ranging from 2,800 to 10,000 kilowatts. The great hydro-electric station at Rheinfelden comes next with 12,360 kilowatts, followed closely by Munich, with 11,300 kilowatts; while the total number of stations of more than 2,000 kilowatts output reaches thirty-eight, with a total of 192,055 kilowatts output, the remaining 730 stations aggregating only 160,515 kilowatts.

It is interesting to note the rapid proportional increase in the use of polyphase currents. Thus in 1900 there were 524 stations generating continuous current, with an output of 123,709 kilowatts; while in 1901 the number of stations has risen to 624, with a product of 172,949 kilowatts, and increase in stations of 19 per cent. and in output of 40 per cent. For polyphase current, however, the number of stations has risen from 39 to 45, and the output from 35,677 to 41,634 kilowatts. This latter is a small increase, but the number of stations generating both polyphase and continuous current has risen from 38 to 43, with an increase in output from 46,608 to 102,511 kilowatts, a gain in product of 120 per cent.

Another interesting feature is the general introduction of accumulators in central and distributing stations. Practically all the sations generating continuous current are equipped with accumulators, and for electric lighting especially this method of equalising the load has been widely adopted.

By far the greater number of stations in Germany are operated by steam power. Of the 768 stations, 463 are driven by steam power, these aggregating an output of 168,314 kilowatts, while 73 are hydro electric stations, generating 15,354 kilowatts, 12,000 kilowatts being the nominal output of the great station at Rheinfelden. The remaining stations are operated either with mixed water and steam power, or by gas, or other internal-combustion motors.

The tabulated statement of the growth of the industry since 1888 shows that the average increase has been more than 100 stations per year, for the past four years, while at the present time there are 90 stations under construction and projected.

A popular conception of the total amount of electrical energy generated at the present time in the German Empire may be given by reducing the total to an equivalent in 16-candle-power incandescent lamps. Reckoning an arc lamp as equivalent to 10 incandescent lamps, and 1 horse-power as equal to 18 lamps, the lamps being assumed to consume 50 watts each, the output of the public stations is capable of supplying 6,591,437 16-candle-power lamps, as against an equivalent of 5,039,217 lamps for the preceding year. This is equal to about 280,000 horse power, or about three times the amount of power now being taken from Niagara Falls.

Hydraulic Propulsion.

Jet propulsion has been a subject of discussion for a long time, and although numerous unsuccessful experiments have been made, it still remains a fertile field for investigation and study.

A very thorough examination of the whole subject, both historical and practical appears in a recent issue of the *Revue de Mécanique*, by M. Marchand Bey, who, from his extensive experience in the construction and operation of centrifugal machinery and hydraulics, is well equipped to discuss it.

The earliest recorded mention of the idea of propelling a boat by the reaction of a discharged jet of water appears to have been due to Daniel Bernouilli about 1730, and he appears to have made some experiments without achieving any noteworthy results. Early and unimportant experiments were also made by Rumsey in 1784, and by Watt, after which the subject dropped out of sight until the important experiments by the British Admiralty in 1866 with the "Water-Witch," built by Ruthven. More recent experiments have been made by Fleischer, Thornycroft, Jackson, Zeuner, and others.

After quoting from Bernouilli and from Rankine that theoretically the propulsion of a vessel by a jet of water should be the nearest to perfection, M. Marchand proceeds to examine the discharge of liquids according to the principle of Torricelli. Considering fixed jets, he first computes the forces of discharge according to the well-known formula of falling bodies, and then applies this to the impact of the jet

against a moving body. From this the work effected may be computed, as well as the velocity of the body impelled by the jet. Extending this investigation to the action of a submerged jet, the conditions are obtained for application to the problem of the propelling effect of a jet issuing from the stern of a boat.

A portion of the effort of the jet acts against the frictional resistance of the periphery of the issuing jet upon the body of water into which it is discharged, a portion of it is exerted in agitating the water, and in general the resistance which it encounters forms the reaction which is available for the propulsion if the boat. In this respect the jet does differ materially from the mass of water impelled by the ordinary screw propeller, and indeed the observer looking aft from a modern fast steamer can distinctly observe the jet of water driven back by the propeller and rising to the surface hundreds of yards astern.

Having examined the jet, M. Marchand discusses the resistance to the advance motion of the boat, this resistance being equated against the reaction of the jet to determine the propulsive effect.

He thus deduces formulas which are so general as to be applicable to any special case, and then proceeds to show by examples how they may be used.

The important question in hydraulic propulsion is the production of the jet. As already observed, the ordinary screw propeller is really a form of jet propeller, and various attempts have been made to increase its efficiency by inclosing the propeller-wheel in a tube or casing, thus converting it into a form of turbine or propeller pump. It is really this form of pump which is advocated by M. Marchand, the pump being constructed within the hull of the boat, drawing the water from beneath the keel and discharging it aft through a tube.

According to the formulas deduced by M. Marchand, the propulsive efficiency of a jet should theoretically reach 94 per cent., and since an efficiency of a screw-propeller pump can attain 80 per cent., it appears that a joint efficiency of 0.75 per cent. should be reached by the combination.

An important feature of hydraulic jet propulsion as compared with the screw propeller lies in the fact that the efficiency is the same for all speeds. This practical fact bears out the theory of Bernouilli and Rankine, while according to Collignon, screw propulsion is defective in that the apparatus commmunicates to the water velocities not only parallel and oppposite to the direction of motion of the boat, but also velocities normal to that direction. These normal components being entirely without influence upon the propulsion, an important portion of the living force of the water is entirely lost.

Discussing the important influence of currents in the stream upon jet propulsion, M. Marchand shows that both in going with, and against a currrent, there is required a definite excess of discharge over that demanded in still water, and deduces formulas from which this excess may be computed.

A very interesting portion of the paper consists of a tabulated account of the character and results of the work of previous experimenters, from Rumsey, in 1784, down to the present time. This table shows the intimate acquaintance of the author with the present state of the subject, and adds meterially to the value of his deductions.

M. Marchand concludes his paper with practical applications of a number of his formulas to examples showing the manner of their use, giving their general character for vessels of any size.

This scientific examination of a question which has been too generally treated in an empirical manner, is most welcome, and should do much to redeem the dubious method of jet propulsion from the discredit which has until now attached to it. Practically all methods of mechanical propulsion depend upon the reaction of a mass of water impelled backward by the propelling mechanism, and with sufficient data given, there is no reason why every branch of the problem should not be examined mathematically and rationally, the empirical element entering only in the case of insufficient data.

A Year's Work on the Simplon Tunnel.

WE have given from time to time abstracts of the quarterly reports upon the great engineering work of the piercing of the Alps at the Simplon Pass, and now we have a general review of the work for the year from January, 1900, to January,

1901, given in recent issues of the *Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines.* This abstract, by Herr Wagner, discusses the geological formations as revealed by the work, as well as the phenomena of the rise of temperature, and considers in detail matters of execution and cost in a most instructive manner.

A general account of the tunnel was given in a review in the issue of this MAGAZINE in August, 1889, but some few leading facts may here be repeated in order to emphasise the report of the progress for the past year. The total length is to be 64,735 feet, or 12.26 miles, nearly 3 miles longer than the St. Gotthard tunnel, but at a lower level than the latter, being only about 2,300 feet above the sea level.

The plan includes the construction of one main tunnel of sufficient width for single track, and of a parallel tunnel of smaller cross section, capable of being enlarged later to full size for a second track. The main tunnel is connected to the auxiliary tunnel by cross cuttings spaced 650 feet apart, exhaust fans connected to the latter enabling complete ventilation to be secured. When the two tunnels are finally completed there will have been much less rock removed than would have been necessary for, a single double gauge tunnel and the cost of the work is distributed over a longer period. The work, which was begun in 1898, was expected to be completed in five and one-half years, and up to the present time the rate of progress has exceeded the estimates.

At the close of December, 1900, there had been completed in the main tunnel a length of 23,842 feet, or about 4½ miles, nearly 37 per cent. of the whole length. The progress during the year 1900 was 11,158 feet, of which 5,968 was the penetration on Swiss side, and 5,190 feet the advance on the Italian side. As this rate is materially greater than was allowed in the original estimate, there is every probability that the work will be completed within the proposed time.

The geology of the tunnel as revealed so far is of interest. On the Swiss side for nearly 2½ miles the rock is a gray slaty limestone, with a strata of granular chalk, containing black mica. Further penetration enters a micaceous dolomite with layers of gneiss, there being numerous small streams of water trickling through the seams.

On the Italian side the formation is similar to the northern portion, the micaceous gneiss containing quartz nodules and crystals of white feldspar, there being less water than on the Swiss side.

One of the most interesting features of the work has been the temperature of the workings. These have been taken regularly, thermometers having been inserted in holes bored about four feet deep in advance of the workings, in order to ascertain the true temperatures of the rock itself. Although the borings have been practically horizontal, the temperatures have steadily increased. At 500 metres the average temperature was about 13 C.; at 1,000 metres this had risen to 16 C.; and at 2,000 metres, 20 C. Borings made when the penetration into the side of the mountain had reached 3,664 metres gave a rock temperature of 28.5° C. on the Swiss side, while similar tests on the Italian side at a penetration of 2,800 metres gave 31° C., or about 88° F.

With progress of the work there has been gained a familiarity with the operations which has facilitated both the speed and the economy. In the earlier operations it required more than 4 kilogrammes of dynamite for the removal of a cubic metre of rock, while during 1900 the consumption of dynamite per cubic metre of rock removed from 1.70 to 2.00 kilogrammes, a notable advance in economy. The rapid progress of the work may be seen when it is understood that the original rate in the engineers' estimate for the close of 1900 was 6,487 metres, or about four miles, while in fact the penetration at that date was 7,267 metres, or 4½ miles.

Since the publication of the report for 1900 there have appeared the first and second quarterly reports for 1901, showing the progress made up to the middle of the present year. At the close of March the penetration in the main tunnel on the Swiss side had reached 4,963 metres and on the Italian side 3,610 metres, a total of 8,303 metres, or 5.16 miles, while at the close of June, 1901, the penetrations were, on the Swiss side, 5,195 metres, and on the

Italian side, 3,977 metres, a total of 9,172 metres, or 5.70 miles. At these depths the rock temperatures reach 34° C., or about 93° F.

The energy with which this great work is being pushed is a remarkable tribute to the progress which has been made in the application of mechanical appliances to engineering work. The Brandt hydraulic drills, which have been used for a large part of the work and which were the invention of the deceased chief engineer of the tunnel, have been most efficient, while the applications of hydraulic power and electric driving have been a marked aid to the rapid progress of the work. The auxiliary tunnel has been an efficient outlet for the removal of rock and debris, enabling the masonry work upon the main tunnel to be pushed with the utmost dispatch, and the whole organisation of the work has shown the value of system and method.

When the tunnel is completed it will afford direct communication between the Rhone valley and northern Italy, and will materially shorten communication between Milan and ports on the North Sea, thus enabling the Jura-Simplon railway to become a most formidable rival to the St. Gothard and Mont Cenis routes for the commerce between Italy and Eastern Europe and England and America.

Modern Turbine Installations.

WITH the development of the electrical transmission of power has come a corresponding revival in the development of water power, and the design and construction of turbines for use in connection with large electrical generating units has assumed much greater importance as a department of mechanical engineering than formerly. As a natural consequence of the absence of coal and the presence of many sources of water power, Switzerland has risen to eminence in the construction of turbines, and hence a recent paper in the *Zeitschrift des Vereines deutscher Ingenieure* upon recent turbine plants, describing important installations by the well-known firm of Escher, Wyss & Co., of Zürich, contains much of interest.

Although modern turbine design has reached a high degree of perfection in Switzerland, the type generally adopted for low and medium heads is based on the American design of Francis, with circumferential inlet and axial discharge. This type has almost entirely replaced the Jonval turbine, and in many instances is also displacing the Girard turbine, the latter being used only for very large units. For units of moderate discharge outlet working under high-pressure, a direct pressure turbine of the Pelton type with spoon-shaped buckets is employed, these three types forming practically all in general use in new installations.

The large installations lately equipped, being of medium head, have been supplied with turbines of the Francis type,, and its good qualities have been fully demonstrated. It is especially well adapted to close regulation, since by dividing the buckets into sections it is possible to have the ring-gates cut off or open up whole sections when necessary, and thus permit nearly as high an efficiency at part gate as at full gate. Thus, at the paper works on the Sihl an efficiency of 86 per cent. is obtained from ¾ to full gate, while at half gate it falls only to 82 per cent., and at ¼ gate an efficiency of 78 per cent. is maintained.

An interesting instance of the replacement of Jonval by Francis turbines is found in the power house at Schaffhausen, above the Falls of the Rhine. Here three Jonval turbines have been superseded by two Francis turbines of greater capacity and higher efficiency, the same walls and foundations being utilised. Here the head of water ranges between 3.8 to 4.5 metres, and the new wheels were to generate 350 horse power each, as against 200 to 260 horse power for the older ones. Under test the Francis turbines exceeded their nominal capacity rating by 80 horse power, with efficiencies ranging from 86.6 per cent. at full gate to 77 per cent. at half gate.

The new installation at Chèvres, near Geneva, is an instance of the installation of a special type of outward discharge turbine in the face of experience with the conical variation of the Jonval turbine. Here 10 double turbines of 900 to 1,200 horse power capacity have been installed, and although the head varies between 4.3 and 8.1 metres an excellent regulation is obtained. An interesting feature of the turbines at Chèvres is the manner in which the pressure

on the step of the vertical shafts has been controlled. In the case of the old wheels there was a heavy pressure on the shaft step, which was relieved by an oil pressure of 15 atmospheres beneath the bearing. In the case of the new turbines this high pressure is avoided. There are two double wheels on each vertical shaft, the lower pair alone operating when the head is high, there being four sets of guide buckets, arranged above and below each double wheel.

In either case the pressure of the water acts partly in opposition to the action of gravity, so that the pressure on the step is reduced to a quantity which can readily be taken care of by an ordinary ring and collar thrust bearing, without requiring any oil-pressure. The special form of centrifugal turbine adopted at Chèvres was chosen because it was desired to obtain as high a rotative speed as possible with a moderate head of water. These wheels are set in a housing of reinforced concrete, a construction which is coming into very general use for such work, for which it offers many advantages.

Another important plant is that recently equipped at Lyons, this constituting the largest hydraulic power plant in Europe; 22,000 horse power being taken from the water of the Rhone. The water is taken from the Rhone above the city of Lyons and conducted through a canal 16 kilometers in length to the power house near Cusset, by means of which a head of 10 to 12 metres is obtained, the water being returned to the Rhone by a tail-race canal 2.6 kilometres in length. Between the ninth and eleventh kilometres of the canal the topography of the ground is such as to form a natural reservoir for the storage of water, this also serving to maintain a fairly constant level of water in the canal.

The power house is being equipped with turbines of the Francis type, there being now installed 8 of 1,250 horse power, 3 of 250 horse power, and 2 of 1,500 horse power, while 6 additional wheels of 1,500 horse power are now under construction.

Each vertical turbine shaft is directly connected to a polyphase generator by Brown, Boveri & Co., of Baden, Switzerland. Each turbine is in a separate cast iron housing and has its own intake pipe, with independent bell vale, in addition to the regulating gates so that the water may be shut off entirely when necessary, the regulating gates being operated by auxiliary hydraulic motors controlled by differential centrifugal governers.

In addition to these imprtant hydro-electric installations in Switzerland and France, a very full description is given of the new turbines for the extension of the Niagara Falls plant. It will be remembered that the original turbines at Niagara, of 5,000 horse power each, were built in America from designs made by Faesch & Picard (now Picard, Pictet & Co.) of Geneva. In the extension of the plant the wheels have been designed by Escher, Wyss & Co., and contain the improvements which have been suggested by the experience with the first installation. By the addition of draft tubes an increase in head is obtained so that 5,500 horse power is obtained from each wheel, with a speed of 250 revolutions per minute, and a higher degree of efficiency is also expected. Instead of double turbines, as in the earlier plant, single Francis wheels are used, the vertical pressure being carried on a counter-pressure piston, in connection with a ring and collar thrust bearing. The governor details have also been modified.

A brief account is also given of the plant at Kubel, near St. Gall, where a fall of 90 metres, with a volume of 4 cubic metres per second. At present there are four wheels of the Pelton type, with spoon-shaped blades, each wheel being of 500 horse power, the fall being capable of extension to about 3,500 horse power. The turbines are directly connected to polyphase generators by Lahmeyer & Co., and furnish light and power to the surrounding neighborhood. A similar plant is now being completed at Flums, for the production of calcium carbide.

This general account of the recent progress which has been made in Switzerland shows that the country has well maintained its high reputation in that especial branch of engineering, while at the same time its constructors have sufficient breadth of view to adopt all that is good from the practice of other lands.

REVIEW OF THE AMERICAN PRESS

Long-Distance Electric Transmission.

ATTENTION has been frequently called in these columns to the tremendous development in water power by reason of the possibilities of the electric transmission of energy to distant points, and the limitations have been shown to rest upon the electric transmission and not upon the generating plant. It is, however, exceedingly unsafe to dogmatize upon the limitations of any branch of engineering, but although the maximum distance has never been positively stated, it has generally been supposed that the San Bernardino-Los Angeles transmission of 80 miles, in California, would long hold the record.

We have now the transmission from the Yuba river to Oakland, also in California, a distance of 142 miles, while with the current delivered to San Jose, the total length of this remarkable transmission of 184 miles, or more than double that of the San Bernardino-Los Angeles line.

From a very complete account of this latest feat in long distance electric transmission, written by Mr. J. D. Galloway, and published in *Engineering News*, we abstract the following account, referring the interested reader to the original paper for fuller details.

"The power stations are situated in the Sierra Nevada mountains, there being three houses on various forks of the Yuba river, the power thus generated being controlled by the Bay Counties Power Company, and much of it transmitted to Nevada City, Marysville, and Oroville over distance of 20 to 30 miles.

"The plant which supplies power to the Oakland line is located at Colgate, about 36 miles from Marysville, the river being at this point about 600 ft. above sea level.

"The dam across the Yuba River is of timber crib construction, 40 ft. high at the deepest point and about 250 ft. wide on the crest. The controlling gates are set in rubble masonry. In winter the water sometimes reaches a depth of 10 ft. over the crest, and the bed of the river has filled up entirely above the dam with gravel.

"The distance from the dam to the penstock on the mountain above the power-house is seven and three-quarter miles. The flume which carries the water from the dam to the penstock has a uniform section, 7 ft. wide and 6 ft. deep. The bottom and sides are of 1½-in. plank, with 4 x 6-in. posts and 4 x 8-in. sills, the bents being 3 ft. c. to c. The grade of the flume is 13 ft to the mile and about 8,000,000 ft., b. m., of lumber was used in the construction. This work, while difficult in places, offers nothing unusual in the way of flume construction.

"The penstock is built of rubble masonry, with a lining of concrete 1 ft. thick. The gates to the pipes are inside the penstock, while manhole pipes, protected with conical hoods, are placed just outside. The penstock is arranged to accommodate five lines of pipe, but at present there are but four lines in place. From the penstock to the power-house the distance along the slope is 1,760 ft., the static head in the pipes being 715 ft., and the average angle of slope about 24° from the horizontal. The contour of the pipe is, however, somewhat irregular, being considerably steeper in parts.

"The upper 800 ft. of the pipes is built of riveted sheet steel, the thicknesses being No. 12, No. 10 and No. 7, in about even amounts. The lower 960 ft. of the pipe is of cast iron, varying from 1 in. to 1¾ ins. in thickness.

"Commercial shapes were used, the lengths being 12 ft. When the pipe passed over bed rock it was anchored with steel straps, and at other places it was set in masses of concrete.

"The pipes, of which there are four, are each 30 ins. inside diameter, and the effective head of water is 695 ft. The flow is at

the rate of 8 ft. per second, with a pressure at the receiver of 300 lbs. per sq. in.

"The water wheels were made by the Risdon Iron & Locomotive Works, of San Francisco, and are the common type of tangential water wheels. Each generator is driven by a water wheel mounted on the same shaft. The water from the pipe lines enters a receiving pipe, which lies parallel with the power-house and is taken from the receiver in 14-in. pipes to the water wheels. At present the generators for the Oakland line are controlled by hand, but Lombard oil governors are to be installed."

One of the points which has been assumed to control the length of long-distance transmission lines is the permissible voltage, it being generally considered that pressures of 25,000 to 30,000 could not be commercially exceeded. For the distance between Yuba and Oakland, however, much higher voltages are successfully used.

At the station at Colgates there are six generators, directly connected to the water wheels, these being 60-cycle, 2,400-volt, inductor machines, the pressure being raised by step-up transformers with winding arranged to give 40,000, 50,000, and 60,000 volts. At the Nevada power house, and at the Brown's Valley power house, are other plants, which, while primarily intended for for the local supply can be called upon to supplement the long-distance transmission in case of emergency.

"The line from the power house at Colgate to Oakland, as before noted, is somewhat more than 142 miles in length. At present the line voltage is 40,000, but this will be increrased to 60,000 volts under increased load. At Oakland the current is transformed to 2,000 volts, this current operating three synchronous motors, direct-connected to 550 volt continuous-current generators of 450 k. each.

"The pole line for the entire distance is in duplicate, the two lines of poles being in general about 25 ft. apart. This duplication was made as an insurance against interruption of the service by accident. One line is of No. 00 medium hard-drawn copper throughout, while the other line is of aluminum from Colgate to Suisun, and of copper for the remaining distance. This was done to avoid the corroding effect of the salt air on the aluminum, in the vicinity of San Francisco Bay. The aluminum cable is composed of seven strands of wire having in total the conductivity of No. 00 copper wire, and was made by the Pittsburg Reduction Co. The standard distance from pole to pole is 132 ft."

The most remarkable feature of the entire transmission line is the crossing of Carquinez straits in the upper part of San Francisco bay.

"Since the high voltage carried on the line prohibited a crossing below the water at that pressure, it became a question of either installing transformer stations on both sides of the Straits to first step down the voltage bv transformers and then after its passage under the river, to step it up again; or to carry the wire across the Straits as an overhead crossing. The danger to cables lying in the bed of a swift river frequented by large ships, the cost of the transformer stations and the constant loss due to the two transformations led to the adoption of the overhead system, although there was no precedent for determining the behavior of cables of such a long span in a heavy wind."

The details of this remarkable crossing are given very fully in Mr. Galloway's paper, but it may be stated that the main span of the cables is 4,427 feet, with a deflection of 227 feet from the highest elevation; this giving a clearance of 208 feet above the water at the lowest point of the wire.

At the present time about 2,000 k. w. is being delivered over the 142 miles between Colgate and Oakland, and the operation appears to be satisfactory both from a technical and commercial point of view.

The Chicago River.

EVER since the opening of the Chicago main drainage channel there has been much discussion about the conflicting questions of the current and the sewage discharge of the Chicago river, comment having been made upon the subject already in these columns.

These questions have been still further discussed at a recent meeting of the Western Society of Engineers, the occasion being the presentation, by Mr. J. J. Johnston, of a paper upon the Chicago river, published in the *Journal* of the society.

The greater portion of Mr. Johnston's

paper is devoted to the problem of the disposal of the sewage of Chicago, and of the necessary flow required for its proper and safe dilution. Since the opening of the drainage channel the current has been diverted from Lake Michigan through the river and canal, and the lake front has been practically free from pollution. This, however, has been accomplished by the production of such a current in the river as materially to interfere with navigation. Hence the conflicting interests, and so far as the society is concerned, the conflicting discussion, for, in some respects, the various members who took part made things exceedingly interesting for each other.

Apart from the personalities which unfortunately appeared, the whole subject is most interesting, and reveals the difficulties which often arise from a divided authority and responsibility. The Chicago drainage canal is a most remarkable engineering work, and has attracted attention and demanded admiration from the entire engineering world. It has freed the magnificent lake front of Chicago from the belt of slimy filth which formerly reached out as far as the crib which forms the intake for the water supply, and it has restored the shore of Lake Michigan to a satisfactory condition. It has reversed the current of the Chicago river, and directed its water toward the Mississippi, so that what was once little more than an open sewer is now a river worthy of the name. Still more important, it has provided a sanitary outlet for the sewage of the great city and given it such a drainage as health and comfort demand.

Mr. Johnston shows conclusively that the legal requirement of 20,000 cubic feet per minute of dilution flow for the sewage of 100,000 people is none too great an allowance, especially in warm weather, and for a city of the population of Chicago this corresponds to about 350,000 cubic feet per minute flow through the river. The Chicago Sanitary District, the legal body which has been authorized to control the sanitary regulation of the Chicago region, is therefore fully sustained in its requirements, so far as sanitary conditions are concerned.

The opposing interests are found in the commercial requirements for the river as a navigable stream. Before the opening of the channel, the river was practically without current, the motion being almost inappreciable, so far as navigation is concerned. The handling of vessels was therefore a comparatively simple matter, and consequently inexpensive.

With the opening of the canal, however, all this has been changed. To those who have become familiar with the currents in the great tidal rivers on the coast, the objections to the current which the canal discharge has produced in the river seem rather unnecessary, but these objections are most natural, coming from those who have been accustomed to the former stagnant waters of the muddy stream.

Being a navigable stream, the river comes under national control, and all regardless of the requirements of sanitation, the government has limited the current to a maximum of 1¼ miles an hour. Experience has shown, however, that this limit is exceeded even before the required discharge of the Sanitary District is reached.

There appear to be but two remedies: either the flow must be restricted or the cross section of the river increased. When it is considered that both banks of the stream are lined with valuable properties, while under its bed are numerous tunnels for tramways, with arch crowns close to the bed-surface, it will be seen that the cost for damages renders enlargement of the prism almost prohibitory. Preliminary estimates make the cost for such an improvement almost equal to that originally required for the building of the canal itself, and preliminary estimates are usually far exceeded when litigation and obstruction have finished their costly work.

There is, however, another remedy, which has not been attempted, namely, the possible modification of the requirements of the national government. Nearly all great engineering works are the result of a number of compromises, and when the health of a great city and the prosperity of its port are closely bound together in such a manner, it is surely reasonable for concessions to be made on both sides.

In this connection a most excellent suggestion has been made by the veteran engineer, General Wm. Sooy Smith, which will bear repeating here. He says:

"As a contribution to the discussion of

the Chicago river, its conditions, and the necessity of the enlargement of the channel, necessary for the flow through it of the quantity of water prescribed by the drainage act, without producing a rate of current that would be detrimental to navigation, I would suggest the necessity of a capacious harbor as a roadstead and place of anchorage for vessels which might require such accommodation, instead of having them crowded into the channel of the river. This suggestion grows out of the advisability of minimizing the difficulty of towing and handling vessels in a rapid current; but the far more important consideration is the fact that the great and increasing commerce of the port of Chicago absolutely requires a capacious harbor for its accommodation. The out-shore breakwater already constructed by the United States government affords nearly all the protection required for such a harbor, and it can be completed at a comparatively small cost, only requiring to be deepened by dredging, which is now being done.

"The river furnishes a certain amount of accommodation as a harbor, and it is valuable as a means of reaching the docks of the city. With the addition of the enlargement proposed and in progress, Chicago will have a harbor commensurate with its needs and importance as the greatest of our lake ports.

"Much of the shipping is now going to South Chicago, and much more will go there and thus relieve to some extent the Chicago river of the duty it is now called upon to perform. The deepening of the harbor will complete the improvement which the Federal government is wisely carrying out on a liberal scale."

The Modernization of an Electric Station.

THE question of depreciation of plant is one which has often been discussed, and the propriety of scrapping machinery while it is yet in condition for many more years of service has been alternately advocated and condemned. The best answer to such questions is found in the examination of actual instances in which such a policy has been adopted, and an excellent example is found in the modernization of the plant at Atlanta, Georgia.

The plant which has just been replaced, according to an account in the *American Electrician,* was entirely new and up to date in 1890, and was typical of the practice of that time, consisting of a large number of small generating units, increased in number as the business of the plant demanded. These additions resulted in the multiplication of machinery types and the conglomeration of small generating sets to such an extent as to overcrowd the station and render operation so difficult and expensive, that, in the spring of 1900, when the oldest portion of the plant was but 10 years old, it was decided to reconstruct the entire station, as well as the system, modernizing the complete plant.

"The general scheme of the present plant, which is almost completed, is as follows: At the main station three-phase alternating currents are generated at 2500 volts and 60 cycles, and a primary distribution system for lighting and power purposes is supplied directly from the alternator bus-bars; this distribution system is restricted to that portion of the city outside of the fire district. The service within the fire district is all direct current, supplied by underground mains from a sub-station located at almost the precise center of the district. This sub-station receives three-phase alternating currents at the voltage and frequency above named, through underground feeders, and transforms these currents, by means of three-phase, two-phase transformers and rotary converters, into direct current, which is delivered to an ordinary three-wire 230-volt Edison distribution system. All arc lamps, motors, and incandescent lamps within the fire district are supplied from these mains, while the lighting and power service without the district is all by alternating current. The municipal arc lamps outside the fire district are series arcs supplied through constant-current transformers in the main generating station. The main station also contains direct-current railway generators of the usual type, which supply the street-railway system of the city. These generators are reinforced by a rotary converter, and an additional rotary is to be put in which will also be used for the railway service."

Instead of a number of small engines the plant is equipped with large compound engines, of the McIntosh-Seymour, Rice &

Sargent, Greene, and Harris-Corliss makes, most of these being direct-connected to the generators, although a few of the old dynamos have been retained and are driven by belt.

The sub-station, located about 1¼ miles from the main station, and close to the distribution centre, contains the transformers, rotary converters, and accumulators, thus enabling the distribution service to be effected with much economy and advantage. The changes in voltage necessitated the rewiring of every customer's premises, and connection to the new mains, all these changes having been accomplished without making any interruption to the service.

Apart from the interest which naturally attaches to such an important piece of technical and administrative work, this operation forms a most striking example of the great changes which have taken place in central station practice in ten years' time, and emphasises the soundness of the position that it pays to scrap old machinery as soon as it has outgrown its usefulness.

Here was a plant, comparatively new, with all its distribution and business organisation, turned over to a new and enterprising corporation. The first act of the new management was to throw the entire plant overboard just as rapidly as it could be replaced by new and improved appliances, even though this involved the placing of new mains and the construction of new buildings. That the commercial advantages of the change must in the long run outweigh the expense is conceded, but it takes courage to act in such a radical manner, the courage that goes with conviction and with knowledge.

Probably the progress of improvement has been more rapid in electrical practice during the past ten years than it has been in some older branches of engineering, but the principle is the same.

Street railway plants have been replaced by cable traction, and this again by electric traction, all within the past fifteen years, and in each case the entire plant has been scrapped, to make way for its successor. The lesson is clear, and in modern works management the question of providing for the rapid depreciation due to the progress of the art can no longer be ignored or disputed.

Standard Water Analyses.

THERE is no more encouraging sign of the progress in the care of the public health than the interest which is taken in the study of methods of prevention of disease, and among these none is more important than the maintenance of a pure water supply.

The report of the committee on standard methods of water analysis, at the recent meeting of the American Public Health Association, published in the *Engineering Record*, gives an excellent idea of the thoroughness with which this problem is being attacked. The report must be examined as a whole for detailed description of the methods which are recommended, but a general view of the subject may be given here.

A specimen of drinking water, when examined according to the reported method, is studied as to its physical characteristics, including turbidity, color, and odor. This is followed by the microscopical examination, in which the bacteria which may be present are studied as to their classification and character, after which the quantitative bacteriological examination is made. As this latter is a most important portion of the work, it is especially desirable that all the data secured at the large number of laboratories both in America and in Europe shall be placed on a comparable basis. For this reason the committee has taken great care to obtain the best available evidence of the methods of procedure in many important laboratories and formulated standard rules for the bacteriological examination of water.

These rules include directions as to the collection of samples of the water to be examined, including cleaning, preparation for transportation, proper temperature, and permissible interval of time between collecting and plating. Standard methods for making sterilized culture media are also given, followed by rules for plating, incubation, and counting.

The committee reports that the responses to correspondence indicate no very great differences in practice in these important details, so that the work of unifying methods is rather one of system than of selection. Nearly all the differences in methods are those naturally due to the differences

in the conditions under which the studies of various investigators are conducted, and it is by no means the intention of the committee to discourage individual methods, but merely to show how such studies may be made to include the data necessary for general and international comparisons.

The work of the committee is by no means considered to be completed, and the present report is merly one of progress, but is sufficiently complete to enable systematic work to be commenced and doubtless to provide material for further suggestions.

The whole question of unifying scientific studies is one which demands careful consideration in all lines of work. Properly carried out, standard methods of investigation must result in the accumulation of an enomous amount of valuable data, where otherwise there would have been but a mass of heterogenous results. At the same time it must remembered that the slavish adoption of codes and rules may act as a serious obstacle to independent investigation unless the student has sufficient judgment to know when to see and how to examine phenomena on his own account. One of the principal disadvantages of standard methods lies in the difficulty which it offers to the discrimination between the work of a thorough investigator and that of a routine subordinate. When a method is reduced to a mere set of rules, which may be followed by the veriest tyro, all reports have a similarity in form which may often obscure the real difference in value and reliability. Method and system are all very well, but these can never supersede independent study and investigation, and each should supplement the other.

The Measurement of Flowing Water.

One of the things which might well be classed with the "way of a bird in the air" or the "way of a fish in the sea," as past finding out, is the way of a stream in its bed, and from the time of Frontinus to the present men have studied the behaviour of flowing water, and attempted to devise methods for measuring its velocity and volume.

Among the appliances which have been used for determining the velocity of water is that known as the Pitot tube. This simple device consists of a tube of which the ower end is bent at right angles to the vertical. When such a tube is placed in a stream with the open end pointing towards the advancing body of water, the velocity of the water will cause it to rise in the tube and the extent of the rise in the tube is used as a measure of the velocity of the flow.

In a paper discussing the formula for use with the Pitot tube, read before the Louisiana Engineering Society by Mr. W. M. White, and published in the Journal of the Association of Engineering Societies, some very interesting and valuable data are collected, which may go far toward extending the use of this device, or rather of extricating it from the disuse into which it has fallen.

Much of the paper of Mr. White is taken up with a controversy with Mr. William Kent as to the value of the coefficient to be used in connection with the tube. Into this controversy it is not our intention to enter, but we do desire to emphasize the importance of the trials made by the writer, as showing the practical value of the device when intelligently used in competent hands.

The experiments by Mr. White include a number in which the study was made of the impingement of jets of water upon flat plates, and upon nozzles of different forms, but the most interesting tests were those in which the tubes were moved through still water at a known velocity, and thus accurately calibrated. One of the important results of these tests was the fact that there was no difference in the readings for tubes with nozzles of different shapes, so long as the nozzle is a surface of revolution with its axis exactly in the line of motion. In all cases the law for the conversion of velocity into static head was shown to be the same as that for the conversion of head into velocity.

An ingenious device for rendering the Pitot tube available for velocities too low to give visible readings by the ordinary scale, is the oil gauge, in which oil is substituted for air in the Pitot tube gauge. By this substitution the difference between the two water levels increases until the difference between the weights of the column of oil and the column of water, due to their different specific gravities, is equal to the

pressure at the point. Thus, with an oil of the specific gravity of 0.9, the scale reading is multiplied ten times.

Comparisons between the Pitot tube and the current meter have shown that when the tube is properly calibrated, and carefully used, it is quite as accurate as the current meter, and very much more convenient. Besides giving a visible reading at once, it permits a study of variation in the velocity, permitting the different parts of the cross section of a stream to be explored and the influence of obstructions, surfaces, etc., upon the velocities to be investigated. It is to such uses of the instrument that we may, perhaps, look for the solution of some problems relating to the flow of water, which are at present unsolved, such as those relating to the internal work of the water, in which, rather than in frictional channel-resistance, much of the resistance to flow may reside.

It is to such investigations as those of Mr. White, rather than to theoretical discussions based on insufficient data, that we must look for increased knowledge of this most important and difficult branch of hydraulic engineering, and it is to be hoped that these studies are but the forerunners of many others.

The Modern Office Building.

SEVERAL years ago a party of French travellers were taken to the top of one of the tall buildings in New York City, and shown the view of the lower portion of the metropolis. Upon being asked what most impressed him, one of the visitors remarked that he was especially struck by the jets of exhaust steam which he perceived issuing from nearly every roof around him.

"I thought these were office buildings, but they look more like factories," was the comment. The remark was more nearly correct than was understood at the time, for the modern office building in most instances contains as much of a power plant as many factories, and is often far more carefully planned.

In a paper recently presented before the American Society of Civil Engineers by Mr. Charles G. Darrach, and published in the *Proceedings* of the society, the general features of the mechanical installation of a modern office building are discussed at length.

"The mechanical installation in the modern office building presents to the engineer a field for the best utilization of his energies. The office building of to-day contains all the conveniences and necessities of a great city, the microcosm of which it is. In addition to the engineering features of a city, a denser population must be provided for; and the varied interests and conveniences of each tenant must be thoughtfully studied in order to make the little city a success.

"In the general arrangement of the apparatus, there must be considered economy of space, comfort, safety and economy in operation; convenience in distribution, adaptability to modification, ease in repairs, and beauty of design; and the machinery must be constructed at the least cost, to be operated at the minimum expense."

As far as possible, an office building should be an individual, depending upon no other, public or private; and it is possible to be independent of everything except primary supplies and sewage disposal. Mr. Darrach divides the necessities into the following heads:

Heating and ventilation,
Lighting,
Water Supplies and Sewage disposal,
Policing and fire protection,
Transportation,
Communication with the outside world.

"The source of power almost invariably adopted is steam, as it can be utilised for heating the building after doing its work in the engines. The boiler power required to heat under the most severe conditions is, except in some very high buildings, generally sufficient to operate the machinery. Practice indicates the installation of from 140 to 200 horse power for maximum use per 1,000,000 cubic feet of contents, with one additional boiler unit in reserve." Data are given showing the conditions under which heating must be effected in various parts of the United States, with examples drawn from actual practice.

Next to heating and ventilation, comes the question of lighting, and the general practice is to use incandescent electric lighting, the 16-candle power lamp being the standard. Experience shows that the maxi-

mum amount of current used will vary from 50 to 60 per cent. of the total installation, including the engine and boiler lighting, one indicated horse power being allowed for 10 to 12 incandescent lamps.

Water supply is an important item in the equipment of the miniature city, and besides the feed for the boilers, water is required for the wash basins, etc., for drinking, for sanitation, and for use in refrigerating apparatus. The source is generally the city water supply, but the water is either pumped directly into the pipe system, or into reservoir tanks in the attic. Fire protection is necessary for the contents of rooms, even though the building itself is fireproof. Fire hose and nozzles must be provided, with electric signals to the engine room; and portable chemical fire-extinguishers conveniently placed on each floor.

The very important subject of transportation, that is, elevator service, is most thoroughly discussed by Mr. Darrach, with a very complete analysis of the actual working conditions of several important buildings in Philadelphia and New York. Tabulated data and formulas are given for computing the area served by elevators in buildings of various heights are given, together with comments upon various details of the apparatus. The preference is undoubtedly given to electric elevators, when a separate source of current from the lighting system can be employed.

"However perfect the installation, without proper management, it will fail; success depends upon the operating engineer, who should be an educated engineer and a cool executive with ready wit, willing hand, and untiring energy, as well as a competent mechanic—the most important machine in the installation."

The Coal Fields of China.

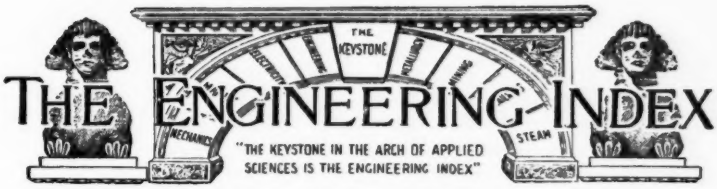
THE great interest which has been given to the coal question in all parts of the world, has included China, and although nearer fields will doubtless attract more attention, the paper of Mr. N. F. Drake, presented before the American Institute of Mining Engineers may be noted briefly, as calling attention to the great coal riches there awaiting development.

Mr. Drake treats of the northeastern portion of the Chinese empire describing those which he himself has mapped and investigated. These include the Kai-Ping field, near Tongshan, the Wang-Ping field, west of Peking, the Ling-Shan field, near Paoting, and the field around Tse-Chou.

The general location of these fields are indicated by an excellent map, and geological sections show the location and depth of seams. The coal is bituminous and produces good coke, but varies in the different localities. The Wang-Ping field has long been worked, the use of the coal having been mentioned by Marco Polo in the thirteenth century, but until recently it has been difficult to get information about them.

Details of the various fields, and the extent to which they are available, are given in Mr. Drake's paper, but the principal fact to which attention may now be called is the enormous quantity which is available for future use. Those who are fearful as to the possible exhaustion of the world's supply of coal should take courage from Mr. Drake's statement. Says he.

"Suppose these fields to represent equal areas, we have a general average of 23 feet for the whole region. This belt has a linear extent of about 500 miles. If we take a width of only 50 miles, and suppose that, because of denuded areas, only one-half is coal-bearing, we still have 12,500 square miles of coal. This would give us about 350,000,000,000 tons, which would be enough to supply the world at its present rate of consumption, for many centuries. It may be doubted whether the coal fields above noted represent average conditions along the whole of this extensive belt: but the figures I have given may be accepted with confidence, so far as they go. In giving estimates I have endeavored to underestimate the probable quantities. If we consider all the workable beds, instead of one big bed, our estimated totals would have to be very much increased. In the Kai-Ping coal field, the big bed contains only about one-third of the workable coal; in the Wang-Ping basin it contains a much smaller proportion; but in the other fields it covers most of the workable coal. A further study of the coal fields is likely to show them to be more extensive than we have supposed hitherto."



The following pages form an index to the contents of nearly two hundred of the leading engineering journals of the world, in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index item gives the following essential information about every article.

(1) The full title, (2) The name of its author,
(3) A descriptive abstract, (4) Its length in words,
(5) When published, (6) Where published.

We supply the article itself, if desired.

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. Thus this Index makes it possible within a few minutes' time each month to inform one's self of every important article published anywhere in the world upon the subjects claiming one's special interest.

The original of any article referred to in the Index, together with all illustrations, can be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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CIVIL ENGINEERING

BRIDGES.

Bridge Renewal.

Sunday Work on Railway Bridges. Discusses the methods of renewal with as little interruption of traffic as possible. 3600 w. Engr, Lond—Sept. 13, 1901. No. 43-348 A.

Caisson Disease.

The Occurrence and Treatment of Caisson Disease in Engineering Work. Facts concerning the limits within which work under compressed air can be carried on, taken from the discussion of a paper by Benjamin Hall Blythe. Also editorial.

We supply copies of these articles. See page 317.

6600 w. Eng News—Sept. 5, 1901. No. 43171.

Concrete Arch.

An Articulated Concrete Arch Bridge. An illustrated account of a proposed structure in Spain, which departs widely from the customary practice of that country. 1500 w. Engr, Lond—Sept. 6, 1901. No. 43223 A.

East River Bridge.

Erection of the New East River Bridge Approaches. Illustrated detailed description of the structures between New York and Brooklyn and their erection. Two independent travelers are in use. 3800 w. Eng Rec—Sept. 21, 1901. No. 43367.

The Temporary Footways of the New East River Bridge. Brief description, with illustrations. 900 w. Sci Am—Sept. 14, 1901. No. 43199.

Foot-Bridge.

The New Foot-Bridge Over the Seine at Paris. Illustrates and describes a structure built for the exposition, but made permanent. 700 w. Engng—Sept. 6, 1901. No. 43224 A.

Highway Bridges.

Highway Bridge Design and Construction. Extracts from a set of general specifications for highway bridges, prepared by C. C. Schneider, with editorial comments on their important features. 3500 w. Eng Rec—Sept. 7, 1901. No. 43120.

Lift Bridges.

Rolling Lift Bridges. Waldon Fawcett. Remarks on the rolling lift bridges constructed during the past few years, and types previously used. Ill. 1400 w. Sci Am—Sept. 28, 1901. No. 43379.

Loads.

Rolling Loads on Railway Bridges. Discusses the best method of determining the effect of rolling loads, considering especially the methods used in England. 2300 w. Engr, Lond—Aug. 23, 1901. No. 43039 A.

Mexico.

American Bridges in Mexico. Illustrates and describes points of interest in bridges manufactured in American shops for the Vera Cruz & Pacific R. R. 1200 w. Eng Rec—Aug. 31, 1901. No. 43088.

Plate-Girder.

The Collapse of a Long Plate Girder Bridge. An account of an accident while testing a bridge in France, in July, 1897. 1500 w. Eng Rec—Sept. 21, 1901. No. 43371.

Red River Bridge.

The Red River Bridge at Alexandria, La. Illustrated detailed description of a bridge being built for the Shreveport and Red River Ry. The bridge proper is 941 ft. in length, and the trestle approach is 4,800 ft. It has three fixed spans and a draw-span. 800 w. R. R. Gaz—Sept. 20, 1901. No. 43335.

Suspension.

A Curious Suspension Bridge. H. G. Tyrrell. Illustrations and brief description of a suspension foot-bridge recently completed at Easton, Pa. It is built with three towers, thus forming two spans. On account of the great difference in the elevation of the two ends the floor has a 7 per cent. grade, and four runs of stairs. 250 w. Sci Am Sup—Sept. 28, 1901. No. 43382.

Swing Bridge.

Four-Track Two-Truss Swing Bridge; Chicago & Western Indiana R. R. Illustrated description of a novel design, with discussion of its advantages. 2000 w. Eng News—Sept. 12, 1901. No. 43191.

Temporary Bridge.

Temporary Bridge Over the Connecticut River at Hartford, Conn. H. G. Tyrrell. Describes briefly the old bridge and the proposed new bridge; but especially the temporary bridge made necessary by the burning of the old structure. Ill. 1300 w. Ry & Engng Rev—Aug. 31, 1901. No. 43083.

Viaduct.

The Gokteik Bridge. J. C. Turk, in the *World's Work*. Extracts of interest from an article by the engineer in charge of the work of erection of the Gokteik Viaduct, Burma. Ill. 2500 w. R R Gaz—Sept. 6, 1901. No. 43156.

CONSTRUCTION.

Building Details.

Dwelling Houses; Their Sanitary Construction and Arrangement. W. H. Corfield. Concerning the proper ventilation of houses. 1800 w. Dom Engng—Sept. 15, 1901. No. 43315 C.

Test of a Vault-Light Slab. Illustrated report of a test to destruction of a concrete-steel slab fitted with lenses for use over sidewalk vaults. 900 w. Eng Rec—Sept. 7, 1901. No. 43127.

The Chicago National Bank Building. Illustrates and describes the construction of a 90½ x 181½-foot four-story steel and brick structure. 2400 w. Eng Rec—Aug. 31, 1901. No. 43090.

The Power House of the Bristol Railway. Illustrates and describes a fire-proof steel building 140 ft. long, 50 ft. wide, and 116 ft. high, constructed in America and erected in England by employees sent for the purpose. 1600 w. Eng Rec—Sept. 21, 1901. No. 43369.

Foundations.

The Foundation for the New York Stock

We supply copies of these articles. See page 317.

Exchange. C. F. Maurice. Illustrated description showing the latest designs and improvements in caisson foundation building. 2100 w. R R Gaz—Sept. 27, 1901. No. 43395.

The Foundation for the New York Stock Exchange. Illustrates and describes the method of sinking the foundation walls and piers, which show many novel features. 1400 w. Ir Age—Sept. 26, 1901. No. 43358.

Framework.

Kinematic Theory of Framed Arches (Kinematische Theorie des Fachwerkbogens). H. Ramisch. An application of kinematic analysis to forms which are statically indeterminate. 2000 w. Zeitschr d Oesterr Ing u Arch Ver—Sept. 6, 1901. No. 43425 B.

The Determination of the Axes of the Internal Members of a Plane Framework (Bestimmung der Achsenlagen der Füllungsglieder ebener Fachwerke). A. Umlauf. An examination of the true axial position of the verticals and diagonals of a truss under deflection. 1800 w. Zeitschr d Oesterr Ing u Arch Ver—Aug. 30, 1901. No. 43422 B.

Mechanical Plant.

Mechanical Installation in the Modern Office Building. Charles G. Darrach. Presents for discussion the various necessities of the modern office building and some general rules for practice which experience indicates. 5500 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42974 E.

Pan-American.

The Ethnology Building at the Pan-American Exposition. Illustrated explanation of the heavy timber framing, including the timber trusses of a dome of nearly 90 ft. diameter. 1800 w. Eng Rec —Sept. 7, 1901. No. 43125.

Simplon Tunnel.

The Construction of the Simplon Tunnel (Der Bau des Simplon-Tunnels). C. J. Wagner. An analysis and discussion of the work upon the Simplon tunnel from January 1, 1900, to January 1, 1901. Two articles. 5000 w. Zeitschr d Oesterr Ing u Arch Ver—Aug. 23, 30, 1901. No. 43-420 each B.

The Work on the Simplon Tunnel (Simplon Tunnel). Report, showing the progress of the work during the quarter ending June 30, 1901. 1200 w. Schweizerische Bauzeitung—Aug. 24, 1901. No. 43-439 B.

Steel-Concrete.

Steel-Concrete Construction. An informal discussion at the annual convention. Ill. 12500 w. Pro Am Soc of Civ Engrs—June 26, 1901. No. 42982 E.

Subway.

The New York Rapid Transit Subway. Illustrated description of details of tunnels and methods of construction of the underground railway now being built. 1700 w. Elec Rev, N. Y.—Sept. 21, 1901. No. 43355.

Tunnels.

The Proposed Tunnel Between Scotland and Ireland. James Barton. Abstract of a paper read before the Glasgow Congress. Discusses briefly the selection of a site, the line, the water question, ventilation and cost. 1300 w. Engng—Sept. 6, 1901. No. 43228 A.

CANALS, RIVERS AND HARBORS.

Bilbao.

Works for Improving the Bilbao River and Making an Outer Harbor, also the Application of Large Caissons as a Breakwater Foundation. Senor Don Evaristo de Churruca. Abstract of a paper read before the Glasgow Congress. Outlines the work and reports the satisfactory results. 1100 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43241 A.

Canals.

The Dortmund and Ems Canal. Herr Hermann. Abstract of paper read before the Glasgow Congress. Describes the route and dimensions of the canal, its ports, cost, and working. 2700 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43-239 A.

Two Interesting Canal Relics. Brief illustrated descriptions of the inclined plane of the Shropshire canal, and the aqueduct of the Shrewsbury canal. 700 w. Engr, Lond—Aug. 30, 1901. No. 43141 A.

Chicago.

I. The Chicago River. Thomas T. Johnston. A discussion of the sanitary and navigation interests. II. Discussion. Isham Randolph. III. Notes on "The Chicago River." Ernest L. Cooley. The last two papers disagree with statements made in the first. 13300 w. Jour W Soc of Engrs—Aug., 1901. No. 43052 D.

Clyde.

The River Clyde and Harbor of Glasgow. W. M. Alston. Extract from paper read before the Glasgow Congress. Describes the "docks," and their equipment, giving information concerning the traffic, revenue, etc. 1600 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43240 A.

Coos Bay.

Description of Coos Bay, Oregon, and the Improvement of Its Entrance by the Government. Discussion of paper by William W. Harts. 10000 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42-977 E.

We supply copies of these articles. See page 317.

Dams.

Stability of Small Dams. John H. Gregory. Gives a series of formulas used by the writer, which give by the solution of one equation the width of the base. Explanations. 2000 w. Eng Rec—Sept. 21, 1901. No. 43368.

Dredges.

Two Sea-Going Suction Dredges. Illustrated general description of two powerful machines to be used in the Southwest pass and Cumberland Sound, South Carolina. 900 w. Marine Rev—Aug. 29, 1901. No. 42997.

Mississippi.

The Improvement of the Lower Mississippi River. J. A. Ockerson. Extracts from a paper read before the Glasgow Congress. An interesting summary of work in progress. Describes the conditions, the revetment and contraction works, levers, etc. 3000 w. Eng News—Sept. 19, 1901. No. 43327.

Nile.

Irrigation in the Nile Valley, and Its Future. W. Willcocks. Read before the Glasgow Congress. Describes the main features of basin irrigation and considers the lessons to be drawn from the wisdom of the ancient Egyptians. Ill. 6200 w. Engng—Sept. 6, 1901. No. 43229 A.

The Regularization of the Nile. Editorial discussion of the river as represented in Sir William Garstin's recent report as to irrigation projects on the Upper Nile. 2000 w. Engng—Sept. 6, 1901. No. 43226 A.

Obstructions.

Obstructions to Commerce and How to Remove Them. Lewis M. Haupt. Discusses the physical obstacles that man must overcome, such as sand bars, peninsulas, isthmuses, etc.; traces the work in this field that has been accomplished in the United States, the cost, etc. 6800 w. Jour Fr Inst—Sept., 1901. No. 43056 D.

MATERIALS.

Building Stones.

Sedimentary Building Stones of Colorado. Arthur Lakes. Illustrated article describing the valuable formations of limestone, sandstone, etc., and the uses to which their colors and qualities are suited. 3000 w. Mines & Min—Sept., 1901. No. 43095 C.

Cement.

Report of the Board of Engineers, U. S. A., on the Properties and Testing of Hydraulic Cement. Almost full report of the investigations of the Board of Engineers on the manipulating and testing of hydraulic cements used in the public works, and the conclusions. 12300 w. Eng News—Sept. 12, 1901. No. 43197.

Fireproofing.

The Fireproofing of Wood. A. H. Eldredge. Methods of fireproofing are described and results given of tests on wood that has been treated. 1700 w. Mach, N. Y.—Sept., 1901. No. 43000.

Paving Brick.

Commercial Brick Testing. Outlines methods of brick testing, giving illustrations. 1300 w. Brick—Sept., 1901. No. 43148.

Tests for Paving Brick. A concise history of the rattler tests. 4800 w. Brick—Sept., 1901. No. 43147.

Tests.

Bridge Metal and Bridge Tests. A synopsis of the report presented by Max Edler von Leber at the International R. R. Cong., at Paris, with the conclusions and comments. 1700 w. R R Gaz—Sept. 13, 1901. No. 43207.

MEASUREMENT.

Metric System.

The Metric Convention and the International Bureau of Weights and Measures (La Convention du Mètre et le Bureau International des Poids et Mesures). C. E. Guillaume. A historical account of the practical development of the metric standards and of the work of the International Bureau at Breteuil. Serial, Part I. 5000 w. Bull Soc d'Encour—Aug. 31, 1901. No. 43430 G.

See Mechanical Engineering, Machine Works and Foundries.

Surveying.

The Solution of Certain Geodetic Problems in Connection with Canal Construction (Ueber Lösungen Geodätischer Aufgaben bei Verfassung der Detailprojecte von Wasserstrassen). J. Urbanski. An analysis of some of the surveying problems connected with the projects for the Danube-Moldau Canal. 2500 w. Zeitschr d Oesterr Ing u Arch Ver—Aug. 30, 1901. No. 43421 B.

Water Measurement.

Instructions for Installing Weirs, Measuring Flumes and Water Registers. Clarence T. Johnston. Illustrated directions for weirs, measuring flumes, and registers, describing in detail the Gurley register, the Friez, the Leitz and the Standard. 3500 w. Eng News—Aug. 29, 1901. No. 43012.

MUNICIPAL.

Garbage Plant.

The Garbage Reduction Plant at Boston, Mass. Describes a plant which combined the Arnold reduction process with a method of ammonia recovery involving the use of by-product coke ovens. Ill.

We supply copies of these articles. See page 317.

3000 w. Eng Rec—Sept. 14, 1901. No. 43268.

Pavements.

Brick Pavements and the Engineer. Taylor Gleaves. Concerning vitrified brick pavements, discussing the early mistakes, and suggesting specifications. 2500 w. Brick—Sept., 1901. No. 43149.

Some Lessons from the Macadam Pavements of Albion, N. Y. Halbert Powers Gillette. Describes a Medina sandstone macadam pavement, the method of construction, cost of repairs, and details of interest. 3000 w. Eng News—Sept. 19, 1901. No. 43331.

The Cost and Durability of Brick Pavements in Ithaca. Extracts from a paper by C. L. Crandall, presented to the League of Am. Municipalities, describing minutely the construction and durability of many brick pavements. 1700 w. Eng Rec—Sept. 7, 1901. No. 43124.

The Design of Economic Streets and Pavements. Halbert Powers Gillette. Discusses economic pavement design, considering the foundation, sub-soil and wearing coat, and criticizes existing designs. 3000 w. Eng News—Sept. 5, 1901. No. 43170.

The Development of Bituminous Pavements. Fred. J. Warren. Read before the League of Am. Municipalities. Reviews briefly the history of this form of pavement, with comments on the various practices. 2000 w. Am Gas Lgt Jour—Sept. 16, 1901. No. 43266.

Sanitation.

Municipal Sanitation. William Weaver. Abstract of a paper before the Glasgow Congress. Discusses sewerage and drainage, water supply, highways and refuse. 1400 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43254 A.

Sewage Disposal.

Sewage Disposal by Intermittent Filtration at the Montgomery Co. Infirmary, Near Dayton, O. Benjamin H. Flynn. Illustrated description of the disposal works, and account of cost. 1000 w. Eng News—Sept. 12, 1901. No. 43196.

The Management of Septic Tanks and Bacterial Contact Beds. Gilbert J. Fowler. From a paper read before the Royal Inst. of Public Health, and published in the London *Contract Journal*. Gives results of experience at Manchester, Eng., discussing the destruction of sludge, the production of an easily vitrified effluent, reduction of suspended matter, etc. etc. 2800 w. Eng News—Sept. 19, 1901. No. 43330.

Sewers.

Difficult Sewer Reconstruction. Harrison Souder. Illustrates difficult work in Philadelphia, where great care had to be exercised to prevent caving, and the operations were rendered more difficult by the presence of many gas, water, and drainage pipes. 500 w. Eng Rec—Aug. 31, 1901. No. 43089.

Flow in the Sewers of the North Metropolitan Sewerage System of Massachusetts. Continued discussion of paper by Theodore Horton. 800 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42980 E.

Street Sweeper.

See Electrical Engineering, Power Applications.

Vienna.

Drainage and Improvement Works at Vienna (Travaux d'Assainissement et d'Embellissement de la Ville de Vienne). R. Philippe. A full account of the improvements made in the past ten years, including the river and sewer regulation, and the metropolitan railway. 3000 w. 1 plate. Génie Civil—Sept. 7, 1901. No. 43407 D.

WATER SUPPLY.

Accidents.

The Accidents at the East Side Water-Works Intake Tunnel, Cleveland, O. Gives a full account of the accidents of Aug. 14 and Aug. 20, resulting in the loss of life. Ill. 2300 w. Eng News—Aug. 29, 1901. No. 43014.

Chicago.

The Water-Works System of Chicago. Brief historical review with illustrations. 3800 w. Fire & Water—Sept. 14, 1901. No. 43262.

The Water-Works System of Chicago. J. H. Spengler. A review of the development and growth, especially the extensive additions and improvements during the past five years. Ill. 23300 w. Jour W. Soc of Engrs—Aug., 1901. No. 43051 D.

Consumption.

The Consumption of Water in Municipal Supplies and the Restriction of Waste. An informal discussion of the annual convention, July 27, 1901. 10900 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42984 E.

Croton Dam.

The Croton Dam for the Water Supply of New York City. Illustrations and brief description of this work, and discussion of some changes that may be considered desirable. 1200 w. Sci Am—Sept. 21, 1901. No. 43325.

Decolorization.

The Decolorization of Water. An informal discussion at the annual convention, June 26, 1901. Ill. 15500 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42983 E

Faucets.

The Design of Faucets of Limited Flow (Dispositifs pour la Limitations du Debit

dans les Bornes-fontaines et Robinets). P. A. Berges. Giving illustrations of forms of faucets requiring the continual action of the user to maintain the flow, thus preventing the waste of water by negligence. 1500 w. Génie Civil—Aug. 17, 1901. No. 43402 D.

Filtration.

The Lawrence, Mass., City Filter: A History of Its Installation and Maintenance. Discussion of paper by Morris Knowles and Charles Gilman Hyde. Ill. 15000 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42978 E.

Ground Water.

The Definition of a Running Underground Stream. Review of a decision by the South Dakota Supreme Court, hinging on a precise definition of a running underground stream. 1000 w. Eng Rec—Sept. 7, 1901. No. 43122.

The Ground Water Supply of Chemnitz, Germany. Description of a supply drawn from wells, of which the yield is artificially increased by diverting part of the water of a neighboring stream over the surface of the land near the wells. 1200 w. Eng Rec—Sept. 7, 1901. No. 43123.

Merthyr Tydvil.

Merthyr Tydvil New Water-Works. An interesting description of this nearly completed work which has been in progress many years and been attended with great difficulties. 2500 w. Engr, Lond—Sept. 6, 1901. No. 43221 A.

Purification.

Purification of Water for House Purposes. W. H. Matlack. Considers ways that water is contaminated, and the means of purification. 3300 w. Dom Engng—Sept. 15, 1901. No. 43314 C.

Reservoirs.

Repairing a Leaking Cofferdam; and Pile-Driving Methods at the Leech Lake Storage Reservoir, Minn. W. C. Weeks. An illustrated description of interesting reconstruction work, describing the methods used to stop leaks, the construction, and details of experiences in connection with the work. 2800 w. Eng News—Sept. 19, 1901. No. 43328.

The New Water Works Reservoir at Trenton, N. J. Charles Arthur Hague. Illustrated description of a reservoir of 110,000,000-gals. capacity, and interesting features of its construction. 2500 w. Fire & Water—Aug. 31, 1901. No. 42993.

Villages.

Some Notes on Village Water Supply. Arthur C. Auden. Considers means of utilizing existing sources, such as wells, springs, etc., and arranging for the distribution. 1700 w. Engr, Lond—Aug. 23, 1901. No. 43040 A.

Wells.

Driven Wells for Fire Purposes. John C. Spencer. Read at Indianapolis convention of the International Assn. of Chief Engrs. Explains the details of construction of a well that has proved very successful for this purpose. Ill. 1800 w. Fire & Water—Aug. 31, 1901. No. 42994.

Well Sinking.

Well Sinking Extraordinary. Describes the methods used in sinking a well in India, to provide water for the use of the palace of H. H. the Maharaja of Bikaner. 1800 w. Col Guard—Aug. 23, 1901. No. 43045 A.

MISCELLANY.

Computing.

Short and Easy Methods for Computing Probable Errors. E. A. Fuertes. Explains the method giving an account of its origin. 2000 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42975 E.

Ethics.

Ethics of the Engineering Profession. Victor C. Alderson. A discussion of the principles underlying this profession and the effect on the mind and character. 3000 w. Jour W. Soc of Engrs—Aug., 1901. No. 43054 D.

Practice.

Civil Engineering Practice: Shall It Be Regulated by Law? Informal discussion at the annual convention. June 26, 1901. 5800 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42981 E.

ELECTRICAL ENGINEERING

COMMUNICATION.

Cables.

A Graphic Proof of the Betts Test. E. Raymond-Barker. Shows the adaptability of Mr. Betts' test for locating faults in submarine cables, to graphic illustration, giving diagram and explanatory notes. 800 w. Elec Rev, Lond—Sept. 13, 1901. No. 43337 A.

Coherers.

See Electrical Engineering, Electro-Physics.

Exchange.

Tunbridge Wells Municipal Telephone

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Exchange. Brief description of a recently opened small system possessing features differing from usual practice. Ill. 1400 w. Elect'n, Lond—Sept. 13, 1901. No. 43338 A.

Field Lines.

Field Telegraph Lines. Sabin Gibbs, Jr. Illustrates and describes systems of field connections, and reports concerning the working of such lines, and the transportation of materials. 3000 w. Elec Rev, N. Y.—Sept. 21, 1901. No. 43356.

Franchises.

The Franchises of Telephone and Telegraph Companies, Legislative, Municipal and Congressional. G. C. Hamilton. Discusses questions relating to the granting of franchises, legislation, etc. 3000 w. Telephony—Sept., 1901. No. 43372.

Selective Signaling.

Telephone Magnetoes for Delivering Pulsating Current for Selective Signaling. N. H. Holland. Describing an improved form of magnets for "individual call" telephone circuits. 1200 w. Elect Wld & Engr—Aug. 31, 1901. No. 43011.

Space Telegraphy.

Experiments with Wireless Telegraphy Between Brussels-Mechlin-Antwerp (Versuche mit Drahtloser Telegraphie zwischen Brüssel-Mecheln-Antwerpen). E. Guarini. A brief description of the apparatus and résumé of the results; the distances ranged from 21 to 41 kilometers. 1800 w. Elektrotech Zeitschr—Aug. 8, 1901. No. 43447 B.

How to Construct an Efficient Wireless Telegraph Apparatus at a Small Cost. A. Frederick Collins. Description dealing only with the practical side of the subject. Ill. 2000 w. Sci Am—Sept. 14, 1901. No. 43201.

Submarine.

Submarine Telegraphy. J. Wright. Reviews the early history of cable lines, the difficulties met; their working, etc. Ill. 4800 w. Ind & East Engr—Aug., 1901. No. 43175 B.

Telephony.

Efficiency of Telephone Generators. W. S. Henry. Gives a method of comparing the capacities of telephone generators. 1400 w. Am Elect'n—Sept., 1901. No. 43069.

Public Co-operation in Perfecting Telephone Service. Joseph B. Baker. Discusses the importance of educating the public in the use of the telephone, thus increasing its efficiency, and greatly lessening delays. 2500 w. Elec Wld & Engr—Sept. 7, 1901. No. 43161.

Telephony from a Scientific Standpoint. Harry S. Coyle. Some remarks on the ignorance concerning the essential principles of the science, and its progress as an art. 1800 w. Telephony—Sept., 1901. No. 43373.

DISTRIBUTION.

Combined Energy.

Distribution of Combined Electrical Energy. Alton D. Adams. Outlines the methods of distributing electrical energy gathered from several sources of generation, describing those used at Manchester, N. H., and Hartford, Conn. 1500 w. Sci Am—Sept. 7, 1901. No. 43106.

Converters.

Motor Generators vs. Rotary Converters. An account of an exhaustive test of two different types of motor-generators of considerable capacity, as to their efficiency, power-factor, rise of temperature, regulation and individual losses. Also editorial. 2800 w. Elec Wld & Engr—Sept. 21, 1901. No. 43364.

High Potential.

The Control of High Potential Systems of Large Power. E. W. Rice, Jr. Read before the Am. Inst. of Elec. Engrs., at Buffalo, Aug. 23, 1901. Outlines the principal features of the switching device employed by the Metropolitan Traction Co. of N. Y., and discusses the principles that should govern the control of current. Ill. 4000 w. Elec Rev, N. Y.—Sept. 7, 1901. No. 43117.

Hydraulic Analogies.

Some Notes on Electric Light and Power Distribution. Daniel W. Mead. Shows the analogies to hydraulic transmission and gives tabulated information of value, and wiring diagram. 1800 w. Munic Engng—Sept., 1901. No. 43049 C.

Insulation.

India-Rubber Strip for Insulation Purposes. H. L. Terry. Notes the increased use of the "spread" strip in preference to "cut," and the reasons. Outlines the processes to which the raw material is subjected, and discusses longevity and other matters of interest. 1600 w. Elect'n, Lond—Aug. 23, 1901. No. 43027 A.

On the Electric Strength of Insulating Materials. C. Baur. Notes on some investigations for determining the electrical breaking strengths. 1300 w. Elect'n, Lond—Sept. 6, 1901. No. 43212 A.

Low-Tension Feeding.

The Relative Advantages of Three-, Two-, and Single-Phase Systems for Feeding Low-Tension Networks. Michael B. Field. Abstract of a paper read at Glasgow Congress. Considers the generating and transforming machinery, and the different systems. 1400 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43257 A.

Regulations.

Government Regulations Affecting Electric Power Distribution. A copy of the

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memorandum of the regulations committee sent to the electrical adviser of the British Board of Trade, with editorial comment. 2500 w. Engng—Aug. 30, 1901. No. 43144 A.

Underground Mains.

Highfield-Cater System of Underground Mains. An illustrated description of a novel system now undergoing a practical trial. Some of the points claimed are small space, no drawing boxes, cheapness and rapidity, thorough protection, etc. 2000 w. Elec Rev, Lond—Aug. 23, 1901. No. 43025 A.

Wiring.

Overhead Wiring Distribution System for Pressures below 1,000 Volts (Installations material für Oberirdische Starkstrom-Vertheillungsnetze mit Spannungen unter 1,000 Volt). H. Bönninghofen. An illustrated description of the practice of the Allgemeine Elektricitäts-Gesellschaft, of Berlin. 2000 w. Elektrotech Zeitschr—Aug. 8, 1901. No. 43446 B.

ELECTRO-CHEMISTRY.

Accumulators.

Edison's Alkaline Storage Batteries. E. J. Wade. From a forthcoming book. Discusses the specifications and information given in paper by Dr. A. E. Kennelly. 2000 w. Elect'n, Lond—Aug. 23, 1901. No. 43028 A.

Electric Furnace.

An Electric-Resistance Magnesia Crucible-Furnace for Laboratory-Use. Prof. Henry M. Howe. Illustrates and describes a furnace designed for the metallurgical laboratory of the School of Mines of Columbia University, N. Y. 1000 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43301 D.

The Use of the Electric Arc as a Means of Fusion (Die Verwendung des Elektrischen Lichtbogens für Schmelzzwecke). Dr. Bermbach. A discussion of the thermal reactions in the use of the electric furnace for fusing alumina, carbide, glass, etc. 3500 w. Elektrotech Zeitschr—Aug. 1, 1901. No. 43443 B.

Electrolysis.

Secondary Reactions in Electrolysis. Joseph W. Richards. States some of the laws of primary electrolysis and secondary reactions, giving a classification of the latter, and discussing examples under each heading by way of illustration and suggestion. 7000 w. Jour Fr Inst—Sept., 1901. No. 43057 D.

History.

The Beginning of Electrolytic Chemistry. Discusses the early work in this field. 800 w. Elec-Chem & Met—Aug., 1901. No. 43021 A.

ELECTRO-PHYSICS.

Coherers.

Some Experiments on Filings Coherers. W. H. Eccles. Describes investigations made to confirm or correct and to amplify the very meagre information available on the effects of steady e. m. f.'s on filings coherers. 3800 w. Elect'n, Lond—Aug. 23, 1901. Serial. 1st part. No. 43029 A.

Discharge-Currents.

The Discharge-Current From a Surface of Large Curvature. John E. Almy. A study of the discharge from a platinum wire of very small size to a concentric, circular cylinder. Ill. 1200 w. Am Jour of Science—Sept., 1901. No. 42985 D.

Iron.

Magnetic Investigations Upon Modern Varieties of Iron (Magnetische Untersuchungen an Neueren Eisensorten). E. Gumlich & E. Schmidt. A report to the Reichsanstalt of the conductivity, coercitive force, permeability, and general magnetic properties of a variety of irons and steels. 10,000 w. Elektrotech Zeitschr—Aug. 29, 1901. No. 43452 B.

GENERATING STATIONS.

Armatures.

The Winding of Continuous-Current Slotted Armatures. Translation of an article by Alexander Rothert in the *Electrotechnische Zeitschrift*. An illustrated discussion of points relating to the manufacture of continuous-current machines. 3800 w. Elec Engr, Lond—Aug. 23, 1901. No. 43023 A.

Alternators.

The Artificial Loading of Alternators (Künstliche Belastung von Wechselstrommaschinen). R. Goldschmidt. A discussion of the heating of alternators under various conditions of loading. 2000 w. Elektrotech Zeitschr—Aug. 22, 1901. No. 43456 B.

Birmingham, Ala.

A Modern Southern Central Station. J. R. Williams. Illustrates and describes the new power house equipment of the Consolidated Light & Power Co., at Birmingham, Ala. 1200 w. Am Elect'n—Sept., 1901. No. 43064.

Dynamos.

Dynamo Ills and Remedies. From the *National Engineer*. A discussion of the cause and remedy of troubles. Ill. 4000 w. Can Elec News—Sept., 1901. No. 43311.

Large Continuous-Current Generators (Grosse Generatoren für Gleichstrom). H. M. Hobart. A comparison of the practice in Europe and America, together with criticisms of the design of Rothert. 2500

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w. Elektrotech Zeitschr—Aug. 15, 1901. No. 43449 B.

The Effect of Short Circuited Field Coils Upon the Operation of an Electric Generator. William Baxter, Jr. Explains the effect upon two-pole and multipolar machines and the reasons. Ill. 2500 w. Marine Engng—Sept., 1901. No. 43074 C.

Efficiency.

The Maximum Efficiency of Continuous Current Generators (Der Maximale Wirkungsgrad von Gleichstrommaschinen). Dr. L. Finzi. A demonstration that the maximum efficiency is attained when the losses due to the unloaded machine and the losses due to the load are equal. 800 w. Elektrotech Zeitschr—Aug. 8, 1901. No. 43445 B.

Farnworth, Eng.

Farnworth Electricity Works and Tramways. Illustrated detailed description of plant for power and lighting. 3700 w. Elec Engr, Lond—Aug. 23, 1901. No. 43022 A.

German Practice.

Some Details of German Electrical Generating Station Practice. E. Kilburn Scott. Illustrated article commenting on points of interest observed during a recent visit by the English Inst. of Elec. Engrs. 1700 w. Elec Wld & Engr—Aug. 31, 1901. No. 43009.

Hydro-Electric Plant.

A Combined Railway and Lighting System in Switzerland. Enrico Bignami Illustrated description of the Alstaetten-Berneck electric railway and the electric lighting of Alstaetten, in the northeast portion of Switzerland. 1600 w. Elec Rev, N. Y.—Sept. 14, 1901. No. 43264.

The Electric Plant at the Poses Dam (Installations Electriques du Barrage de Poses). E. Bret. An illustrated description of the plant at Poses on the Seine, near Amfreville, where about 13,000 h. p. is developed at mean water. Especial measures are provided for variable flow. 2500 w. 1 plate. Génie Civil—Aug. 24, 1901. No. 43403 D.

Water Powers of the Springfield, Mass., United Electric Light Company. Alton D. Adams. Illustrated description of the plants established by this company for utilizing the power of nearby water falls. 3500 w. Elec Wld & Engr—Sept. 28, 1901. No. 43392.

Joint Works.

The Kensington and Notting Hill Companies' Joint Electricity Supply Works. Illustrated detailed description of the works. The alternating-current system is used, and three-phase generators. 4000 w. Elect'n, Lond—Sept. 6, 1901. Serial. 1st part. No. 43210 A.

Parallel Running.

Parallel Operation of Alternators. A. S. M'Allister. Discusses the operation on the output side of the machines. 1500 w Am Elect'n—Sept., 1901. No. 43067.

Polyphase.

Polyphase Electric Working. A. C. Eborall. Howard Lecture. Deals with the machinery employed in polyphase working, discussing the leading features. The present lecture considers the design and construction of three-phase generators. Ill. 3600 w. Jour Soc of Arts—Sept. 13, 1901. Serial. 1st part. No. 43336 A.

Prague.

The Electrical Power Station of the City of Prague. Notes on this plant, taken from the *Zeitschrift*, of the society of German Engineers. Ill. 2500 w. Eng Rec—Aug. 31, 1901. No. 43087.

Reconstruction.

Reconstruction of a Water and Electric Lighting Station at Warren, O. Drawings and photographs showing the improvements made, with account of the works, and facts of interest concerning them. 1600 w. Eng News—Sept. 5, 1901. No. 43168.

Regulation.

Compensation of Alternators for Circuits of Varying Power Factors. Sydney Woodfield. Gives a description of the automatic regulating apparatus of the General Electric Company, etc. 1100 w. Elec Rev, Lond—Aug. 30, 1901. No. 43132 A.

Single-Phase.

The Prospects of Single-Phase Supply. W. E. Warrilow. Discusses the prospect of single-phase supply for tramways, and reviews the past history, concluding that the method is not on the decline. 2000 w. Elec Engr, Lond—Aug. 23, 1901. No. 43024 A.

Switchboards.

The Design of Switch Gear. W. E. Warrilow. The present number is principally devoted to high pressure gears. 1700 w. Elec Rev, Lond—Sept. 6, 1901. Serial. 1st part. No. 43214 A.

Tyne.

Electric Power Supply on the Tyne. The present article gives an illustrated description of the Neptune Bank Station, with the history of the undertaking. 1800 w. Engr, Lond—Sept. 13, 1901. Serial. 1st part. No. 43351 A.

LIGHTING.

Isolated Plant.

The Electric Light and Power Installation at the Lancashire County Asylum, Prestwich, England Illustrated detailed

We supply copies of these articles. See page 317.

description. 4000 w. Elec Engr, Lond—Aug. 30, 1901. No. 43133 A.

Lamp Sockets.

The Testing of Gauges for Edison Lamp Sockets (Bestimmungen betreffend die Prüfung von Lehren für die Füsse und Fassungen von Edison Glühlampen). A discussion of the standard threads for lamp sockets recommended by the *Verband Deutscher Elektrotechniken* and adopted by the Reichsanstalt. 3500 w. Elektrotech Zeitschr—Aug. 15, 1901. No. 43448 B.

Luminous Fountains.

A Brief History of Luminous Fountain Development. Luther Stieringer. An elaborately illustrated article giving the history as far as known of illuminated fountains. 4800 w. Elec Wld & Engr—Sept. 14, 1901. No. 43187.

Nernst.

Investigations on the Nernst Lamp (Untersuchungen über die Nernst lampe). Dr. W. Wedding. Giving details of photometric tests of various models, with numerous diagrams. 3500 w. Elektrotech Zeitschr—Aug. 1, 1901. No. 43442 B.

Vapor Lamp.

The Cooper-Hewitt Vapor Lamps. An account of the ten patents recently issued, with illustrated description of the lamp and its operation. Also editorial. 9200 w. Elec Wld & Engr—Sept. 28, 1901. No. 43393.

MEASUREMENT.

Galvanometer.

Shunt for Galvanometers (Nebenschlusskasten für Galvanometer). W. Volkmann. Description of a special form of shunt for varying the sensitiveness of a galvanometer. 1000 w. Elektrotech Zeitschr—Aug. 15, 1901. No. 43450 B.

Instruments.

Kelvin's Electric Measuring Instruments. Prof. Magnus Maclean. Read before the Elec. Section of the International Engng. Cong. at Glasgow. (Abstract.) Brief illustrated descriptions of various classes of instruments patented by Lord Kelvin. 2500 w. Elec Rev, Lond—Sept. 6, 1901. No. 43215 A.

Meter.

Graduated Tariff Meter for Consumers (Verbrauchs-Stufenmesser und Selbstthätige Staffel-Tarifanzeiger). Dr. Kallman. Describing an automatic recording meter for varying rates of charge for current to the consumer. 5000 w. Elektrotech Zeitschr—Aug. 22, 1901. No. 43455 B.

Polyphase.

Polyphase Measuring Appliances (Ueber Drehfeldmessgeräthe). F. Schrottke. Illustrated description of the apparatus made by Siemens & Halske of Berlin. 10,000 w. Elektrotech Zeitschr—Aug. 15, 1901. No. 43451 B.

Testing.

The Rating and Testing of Electrical Machinery. Gisbert Kapp. Gives the standards provisionally adopted by the German Assn. of Elec. Engrs., discussing the subject. 5400 w. Inst of Mech Engrs —Glasgow Congress, 1901. No. 43280 D.

POWER APPLICATIONS.

California.

Electric Power Plants in the Mining Districts of Northern California. G. P. Grimsley. Briefly reviews some of the plants in use and proposed. 1100 w. Eng & Min Jour—Aug. 31, 1901. Serial. 1st part. No. 43004.

Cranes.

Electric Equipment of Cranes. Will Rung. Deals with the various types of motor applicable to crane work, having reference also to the nature of the supply current. Also the controlling gear. Ill. 2000 w. Elec Rev, Lond—Sept. 6, 1901. Serial. 1st part. No. 43217 A.

Electric Printing.

Spence's Electric Motors for Hoe Four-Roll Printing Machine. Illustrated description of the machine, its electric appliances and operation. 2400 w. Engng—Aug. 23, 1901. No. 43038 A.

Elevators.

Electrically Controlled Hydraulic Elevators. William Baxter, Jr. An illustrated description of an elevator so arranged as to not require an attendant operated by electricity obtained from direct current incandescent lighting circuits. 1300 w. Am Mach—Sept. 12, 1901. Serial. 1st part. No. 43186.

Induction Motor.

Asynchronous Induction Motor Without Phase Variation Between Current and Pressure (Asynchroner Induktions motor bzw. Generator ohne Phasenverschiebung zwischen Strom und Spannung). A. Heyland. The rotary field is produced from the secondary armature, and a closed commutator is used. 2000 w. Elektrotech Zeitschr—Aug. 8, 1901. No. 43444 B.

Measurement and Computation of the Losses of Unloaded Induction Motors (Messung und Berechnung der Leerlaufverluste von Drehstrommotoren). Dr. G. Beniscke. Describing the application of the stroboscopic disk for the determination of slip at various loads. 2500 w. Elektrotech Zeitschr—Aug. 29, 1901. No. 43453 B.

The Induction Motor for Electric Railways. The present article gives an abstract of a recent paper by Albert H. Armstrong

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entitled "Notes on Modern Electric Railway Practice." 3000 w. Elec Wld & Engr—Sept. 14, 1901. Serial. 1st pa... No. 43189.

The Induction Motor. Harris C. Trow. An explanation of the induction motor and its action. 3400 w. Engr, U. S. A.—Sept. 1, 1901. No. 43077

Mill Power.

Electric Power Equipment for Dominion Cotton Mills Company. Illustrated description of the installation of electric power in mills at Montreal. 4000 w. Can Engr—Sept., 1901. No. 43081.

Polyphase.

Report on the Wüst Polyphase Motor (Bericht über Untersuchungen an einem Drehstrom-Motor mit Abstufbarer Tourenzahl; Patent Wüst). Drs. Weber and Denzler. Description of a polyphase motor with speeds ranging from 700 to 1,500 revolutions per minute. 2500 w. Schweizerische Bauzeitung—Aug. 31, 1901. No. 43440 B.

The Computation of the Short-Circuit Current in Polyphase Motors (Die Berechnung des Kurzschlusstromes von Drehstrommotoren). A. Siewert. A mathematical investigation, showing the relation between the short circuit current and the magnetization. 5000 w. Elektrotech Zeitschr—Aug. 1, 1901. No. 43441 B.

Pumping.

Electrically-Operated Pumps. Frank C. Perkins. Illustrates and describes various types of centrifugal pumps operated electrically, and states the purposes for which they are especially suited. 1600 w. Sci Am Sup—Sept. 14, 1901. No. 43202.

The "Bull" Electric Motor. Illustrated description of an English motor for driving a pump. 500 w. Engng—Sept. 13, 1901. No. 43344 A.

Street Sweeper.

An Electric Street Sweeper. Waldon Fawcett. Illustrates and describes a novel sweeper used in Cleveland, O. 800 w. Munic Engng—Sept., 1901. No. 43050 C.

TRANSMISSION.

Canada.

The Chambly-Montreal Power Transmission. Illustrated description of an important medium-distance high-tension two-phase transmission line in Canada. 2400 w. Elec Rev, N. Y.—Sept. 14, 1901. No. 43265.

Line.

Some Details of High-Tension Pole Line Construction. C. O. Pole. An illustrated description of the pole line construction adopted by the Standard Electric Co., of California, confined principally to the mechanical construction. 4000 w. Jour of Elec—Aug., 1901. No. 43352 C.

The Bay Counties Transmission Line. C. E. Dutcher. Illustrated detailed description of a double pole line of best material and workmanship. 2300 w. Jour of Elec—Aug., 1901. No. 43353 C.

Long Distance.

Elements of Design Particularly Pertaining to Long-Distance Transmission. F. A. C. Perrine. Presented at the annual convention of Am. Inst. of Elec Engrs., at Buffalo. Considers important phenomena in connection with long-distance problems. 2500 w. Elec Rev, N. Y.—Aug. 31, 1901. No. 43001.

MISCELLANY.

Germany.

Visit of the Institution of Electrical Engineers to Germany. E. Kilburn Scott. An interesting account of the visit of this British society, the works inspected, etc. Ill. 3800 w. St Ry Jour—Sept. 7, 1901. No. 43166 D.

Radiography.

Origin and Uses of the X-Rays. Dr. W. R. Fox. Digest of a lecture delivered before the Insurance Institute of Victoria, N. S. W., with descriptions of demonstrations given to illustrate the principles. 2800 w. Aust Min Stand—July 25, 1901. No. 43145 B.

Standardization.

The Standardization of Electrical Apparatus. J. T. Broderick. The subject is discussed from the standpoint of the manufacturer mainly, showing its manifest advantages. 2600 w. The Engineering Magazine—Oct., 1901. No. 43481 B.

GAS WORKS ENGINEERING

Acetylene.

The Position of Calcium Carbide and Acetylene. Reviews an article by Dr. Münsterberg, recently published in the *Zeitschrift für Beleuchtungswesen*. 2000 w. Engr, Lond—Sept. 13, 1901. No. 43350 A.

Address.

Inaugural Address of the President of the Gas Section of the International Engineering Congress in Glasgow. George Livesey. 3000 w. Jour Gas Lgt—Sept. 3, 1901. No. 43172 A.

We supply copies of these articles. See page 317.

Analysis.

Estimation of Phosphorus and Suphur in Acetylene and Other Combustible Gases. Describes a combustion method, with the use of oxygen. 2500 w. Jour Gas Lgt—Aug. 27, 1901. No. 43115 A.

Automatic Apparatus.

Automatic Lighting and Extinguishing Apparatus. M. A. Rothenbach. Read before the Gas Section of the Glasgow Congress. Explains clock work apparatus made in Switzerland and states its advantages. Discussion. 1700 w. Gas Wld—Sept. 7, 1901. No. 43209 A.

Carbonizing.

The Construction of Inclined Retort Carbonizing Plants. Walter Ralph Herring. Read before the Gas Section of the Glasgow Congress. Considers the differences between British and Continental practice, the types, distinctive features, charging and discharging, coke conveyors, regenerative chambers, etc. Also discussion. 10000 w. Gas Wld—Sept. 14, 1901. No. 43339 A.

Coke-Oven Gas.

The Production of Illuminating Gas From Coke-Ovens. F. Schniewind. Read before the Glasgow Congress. Describes the progress made in the United States and Canada in recovering illuminating gas from bye-product coke-ovens, discussing its bearing on the smoke problems. Discussion. Ill. 17000 w. Jour Gas Lgt—Sept. 17, 1901. No. 43398 A.

Consumers.

The Relation of the Consumers to the Gas Manager. S. B. Langlands. Read at the meeting of the Irish Assn. of Gas Mgrs. Considers the best means of strengthening the relationship. General discussion follows. 4000 w. Gas Wld—Aug. 14, 1901. No. 43030 A.

Electrolysis.

Destruction of Gas-Pipes by Means of Electricity. Dr. W. Leybold. Read before the Gas Section of the Glasgow Congress. An explanation of the action of the electric current, with description of the conditions found. General discussion. 6500 w. Jour Gas Lgt—Sept. 10, 1901. No. 43320 A.

Enrichment.

The Influence of Enrichment on the Heating Power of Coal Gas. M. Verdier. Read at annual meeting of the Société Technique. An account of tests with interesting conclusions concerning the heating and illuminating value of coal gas 2200 w. Jour Gas Lgt—Aug. 27, 1901 No. 43114 A.

Gas Brackets.

See Mechanical Engineering, Machine Works and Foundries.

Gasholder.

The Principles of Construction of a Proposed Modern Gasholder for Amsterdam. J. Van Rossum du Chattel. Read before the Gas Section of the Glasgow Congress. An illustrated description of an annular tank above the ground, the largest of the kind ever constructed. States the conditions, difficulties, and methods. Discussion. 4400 w. Gas Wld—Sept. 14, 1901. No. 43340 A.

Gas Transmission.

A Long Gas Transmission System. Illustrated description of a series of pipe lines owned and operated by the Philadelphia Co., of Pittsburg, and used for the transmission of natural gas from the gas producing district they control to various points of consumption. 700 w. Compressed Air—Sept., 1901. No. 43285.

Purification.

Application of the Unit System of Gas Manufacture to Its Purification. Charles Carpenter. Read before the Gas Section of the Glasgow Congress. Describes an experiment tried and the results obtained. General discussion follows. Ill. 5500 w. Jour Gas Lgt—Sept. 10, 1901. No. 43321 A.

Station Lighting.

Evolution: Old Lamps and New for Railway Station Lighting. Showing the advantages of the latest scientific methods of gas lighting. 1800 w. Jour Gas Lgt—Aug. 27, 1901. No. 43112 A.

Water Gas.

Experience with Carburetted Water Gas Sets. A. C. Beck. Read before the Pacific Coast Gas Assn. An illustrated account of improvements introduced at Oakland, Cal., to overcome defects in manufacture and aid in the efficiency of the machines. Also discussion. 4500 w. Am Gas Lgt Jour—Sept. 9, 1901. No. 43151.

The Utilization of Water Gas in the Destructive Distillation of Coal. Vivian B. Lewes. Read before the Gas Section of the International Engng. Cong. at Glasgow. Describes experiments made at the Crystal Palace Dist. Gas. Works, showing the great economy obtained. Discussion. 8300 w. Gas Wld—Sept. 7, 1901. No. 43208 A.

Welsbach.

The Welsbach "Patent" of 1893. Information of importance regarding the validity of this patent, with editorial comment. 4000 w. Jour Gas Lgt—Aug. 27, 1901. No. 43113 A.

We supply copies of these articles. See page 317.

INDUSTRIAL ECONOMICS

Cost-Keeping.

The Proper Distribution of Establishment Charges. A. Hamilton Church. The present article deals with the classification and dissection of shop charges, showing the method and its advantages. 4500 w. The Engineering Magazine—Oct., 1901. No. 43482 B.

Labor.

A Plan to Utilize Unemployed Labor. James A. Stewart. Outlines a plan for building homes by co-operation and giving employment to the unemployed in their own business. 1800 w. Jour Assn of Engng Socs—Aug., 1901. No. 43288 C.

Labor Questions.

Some Aspects of the Labor Question and Shop Ethics. Egbert P. Watson. A discussion of some of the points that cause disturbances in labor. 4800 w. Ir Age—Sept. 19, 1901. No. 43312.

Premium System.

A Premium System of Remunerating Labor. James Rowan. Describes a premium system tried in an effort to solve the piecework problem. 2400 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43279 D.

The Premium System of Remunerating Labor. James Rowan. Abstract of a paper read at the Glasgow Congress. Gives a description of a premium system used in marine-engine manufacture. 2400 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43259 A.

Profit-Sharing.

Mr. W. H. Lever on Profit-Sharing. Discusses the objections set forth by Mr. Lever in published articles. 2500 w. Jour Gas Lgt—Aug. 27, 1901. No. 43111 A.

Steel Strike.

The Outcome of the Steel Strike. Gives the strikers' view of the causes of their failure, including President Shaffer's statement. 2500 w. Ir Trd Rev—Sept. 26, 1901. No. 43386.

Trusts.

European Trusts. Reviews the report compiled by J. W. Jenks, the United States Industrial Commission's trust expert, concerning investigations extending over two years and embracing visits to the leading European industrial centers. 2000 w. Col Guard—Sept. 13, 1901. No. 43342 A.

Wages.

Wages in the German Coal Industry. A statement of the present condition of the industry, the reductions made in wages, and the question of Polish labor. 1700 w. Col Guard—Sept. 13, 1901. No. 43341 A.

MARINE AND NAVAL ENGINEERING

Battleships.

Contract Trial of the United States Sea-Going Battleship "Illinois." James M. Pickrell. Illustrated detailed description of the vessel and its equipment with report of trial. 7200 w. Jour Am Soc of Nav Engrs—Aug., 1901. No. 43302 H.

Trial of Great Battleships. An account of the trial of the "Retvizan," built for the Russian government. The builder's tests made in the Atlantic, off Delaware capes. 1200 w. Naut Gaz—Sept. 19, 1901. No. 43357.

Boilers.

See Mechanical Engineering, Steam Engineering.

Boiler Trials.

The Boiler Trials of H. M. S. "Hyacinth" and "Minerva." Official report and editorial discussion. 7300 w. Engng—Aug. 30, 1901. No. 43142 A.

Compass.

A Study of the Compass (Studio sulla Bussola). G. Pes. A theoretical and mathematical investigation of the magnetic deviation of the compass. 7000 w. Rivista Marittima—Aug.-Sept., 1901. No. 43462 H.

Corrosion.

A Simple Method for Preventing the Corrosion of Tail Shafts. James M. Thornton. Describes the author's method of protection and preservation, which experience has shown will make them last for years without breaking. Also discussion and plate. 2700 w. Trans of N. E. Coast Inst. of Engrs. & Shipbuilders—July, 1901. No. 42992 E.

Cruisers.

Some Notable Scottish Products. Illustration, with description of two cruisers of the County class, with their engines

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and machinery. 2600 w. Marine Rev—Sept. 19, 1901. No. 43323.

Displacement.

The Displacement and Dimensions of Ships. J. A. Normand. Read before the Glasgow Congress. Give approximate rules for the determination of the displacement and dimensions of a ship in accordance with a given programme of requirements. 2000 w. Engng—Sept. 6, 1901. No. 43233 A.

Explosions.

Racing Steamboats and Exploding Boilers. Editorial maintaining that steamboat racing is not dangerous, and giving some explanatory notes on the modern type of boiler. 1400 w. Eng News—Sept. 12, 1901. No. 43194.

Fog Signals.

Foster's Fog Signals. Illustrated description of this apparatus, which is in the form of a single automatically revolving megaphone, which turns to each of the eight points of the compass in turn, and gives a signal. 1000 w. Sci Am—Sept. 28, 1901. No. 43380.

Grounding.

The Grounding of the German Battleship "Kaiser Friederich III." Translated from *Marine Rundschau*. An account of the circumstances attending the grounding of this vessel on the 2nd of April, 1901, causing considerable damage, and the lessons taught by the accident. Ill. 5300 w. Jour Am Soc of Nav Engrs—Aug., 1901. No. 43304 H.

Hulls.

Hull Design. George Crouse Cook. Considers the efficiency as determined by the form of the under-water body. 1400 w. Marine Rev—Sept. 26, 1901. No. 43385.

Jet Propulsion.

A Study of Hydraulic Propulsion (Etude de la Propulsion Hydraulique). Marchand Bey. A mathematical analysis of the hydraulic principles involved in jet propulsion, with examples of practical application. 3000 w. Revue de Mécanique—Aug. 31, 1901. No. 43428 + F.

Launch.

Launch of the Mallory Steamer "Denver." Illustrates and describes a launch of more than ordinary interest because of the great dimensions and weight of the vessel, and the narrow stream into which she was launched. 3500 w. Marine Engng—Sept., 1901. No. 43072 C.

Liner.

The New Atlantic Liner "Kronprinz Wilhelm." Brief illustrated description of this large, high-speed vessel. 700 w. Sci Am—Sept. 14, 1901. No. 43198.

The New German Atlantic Liner "Kronprinz Wilhelm." Describes this new high-speed liner and its equipment, reporting the trial. 1800 w. Engng—Sept. 13, 1901. No. 43347 A.

Mexico.

Steam Navigation on the Rivers of Tabasco. Abstract of a contract to establish regular steam navigation on the rivers of the State of Tabasco. 500 w. U. S. Cons Repts, No. 1,139—Sept. 14, 1901. No. 43178 D.

Navies.

Engineering in the Royal Navy. The first of a series of articles, considering the true position of machinery and those employed in working and tending it on board men-of-war. 1800 w. Engr, Lond—Aug. 30, 1901. No. 43140 A.

The World's Navies. Information from the government annual showing progress made in vessel construction and armament. 3000 w. Naut Gaz—Sept. 5, 1901. No. 43118.

Oil Motors.

See Mechanical Engineering. Special Motors.

Shallow Water.

Shallow Water Navigation. William H. Crawford, Jr. Remarks on the designs of boats for the shallow rivers of the United States and how well they accomplish the work required of them. Ill. 1800 w. Marine Engng—Sept., 1901. No. 43073 C.

Shipbuilding.

Plant of the New York Ship Building Company. Waldon Fawcett. An account of this new yard at Camden, N. J., and its equipment. 2500 w. Am Mfr—Sept. 5, 1901. No. 43109.

The Clydebank Shipbuilding and Engineering Works. The present article describes the general arrangements of the works, the building berths and launching ground, the ship platers and fitters' department, mechanics' shop, woodworking department, etc. Ill. 3800 w. Engng—Aug. 23, 1901. Serial. 1st part. No. 43033 A.

Shipping.

The Waste of Shipping. Editorial comments based on Lloyd's Return, just issued. 1200 w. Engng—Aug. 23, 1901. No. 43036 A.

Ship Ventilation.

Mr. F. W. Jennings' Reply to the Discussion of His Paper on "The Ventilation and Heating of Ships." 2300 w. Trans of N-E Coast Inst of Engrs & Shipbuilders—May, 1901. No. 42988 E

Shipyards.

Some Remarks on the Commercial Organization of Shipyards. Walter Scott.

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Considers the subject under the headings of correspondence, estimating, buying, cost-keeping, bookkeeping, commercial staff, and development. Also general discussion. 7700 w. Trans of N-E Coast Inst of Engrs & Shipbuilders—May, 1901. No. 42987 E.

Steamship Line.

A Great Vessel Organization. From *Fairplay*. History of the City line purchased for the Indian trade. 2400 w. Marine Rev—Sept. 12, 1901. No. 43177.

Torpedo Boats.

Contract Trials of the Torpedo Boats Shubrick and Thornton. H. Webster. Illustrated detailed descriptions of the boats and their equipments, with account of trials. 5000 w. Jour Am Soc of Nav Engrs—Aug., 1901. No. 43303 H.

Largest Torpedo Boats of Any Navy. Brief illustrated description of the torpedo boat destroyers "Truxtun," "Whipple," and "Worden" of the U. S. government. 600 w. Marine Rev—Sept. 26, 1901. No. 43384.

U. S. Torpedo Boats, "Bagley," "Barney," and "Biddle." Charles P. Wetherbee. Illustrated detailed descriptions of these vessels, with report of trials. 2800 w. Jour Am Soc of Nav Engrs—Aug., 1901. No. 43305 H.

Torpedoes.

Discharging Torpedoes by Electricity. Describes the process of launching a torpedo, with diagrams. 1500 w. Elec Rev, Lond—Aug. 30, 1901. No. 43130 A.

Turrets.

Shipbuilder Cramp's Views on Battleship Turrets. Letters to the chief constructor of the United States navy. 4400 w. Naut Gaz—Sept. 26, 1901. No. 43389.

Warships.

The Protection of Warships in the Nineteenth Century (La Protegione delle Navi da Guerra nel Secolo xix). A. Ruggieri. A general study of armored protection of vessels at the close of the century. 8000 w. Rivista Marittima—Aug.-Sept., 1901. No. 43463 H.

Water-Tight Compartments.

Water-tight Subdivision of Ships. Theodore Lucas. Discusses the importance of this subject at the present time, and where the bulkheads ought to be placed, their construction, etc. 1500 w. Naut Gaz—Sept. 5, 1901. No. 43119.

Yachts.

Twin Screw Pleasure Yacht "Prinzessen Victoria Luise." Illustrated description of a new type of pleasure steamer built for long cruises. 600 w. Marine Engng—Sept., 1901. No. 43071 C.

MECHANICAL ENGINEERING

AUTOMOBILES.

Axle.

A New Driving Axle for Automobiles. Sectional view, with description. 800 w. Sci Am—Sept. 21, 1901. No. 43324.

Cylinder Cooling.

Cooling of the Cylinders of High Speed Internal Combustion Engines and Its Effect Upon the Power Developed. Prof. Hele-Shaw. Read before the Mech. Engrs. Sec. of the Glasgow Con. Discusses the overheating of the cylinders and its prevention. Ill. 1700 w. Autocar—Sept. 7, 1901. No. 43219 A.

Endurance Run.

Impressions of the New York-Buffalo Endurance Contest. Albert L. Clough. A report of lessons learned from this recent trial concerning the weak points of the machines, and other matters of interest. Conclusions, remarks and editorial. 7400 w. Horseless Age—Sept. 18, 1901. No. 43317.

The New York-Buffalo Endurance Run. An account of the entries, the start, the first and second stages of the run, the hill climbing contest, and much matter of interest. Ill. 10800 w. Horseless Age—Sept. 11, 1901. No. 43180.

The New York-Buffalo Endurance Run. Detailed report of the third, fourth, fifth and sixth stages, with comments. 9500 w. Horseless Age—Sept. 18, 1901. No. 43318.

Gasoline Vehicle.

The Rocket-Schneider Gasoline Vehicle. From *La France Automobile*. Illustrated particulars concerning this machine. 1800 w. Horseless Age—Sept. 4, 1901. No. 43105.

Glasgow Trials.

Glasgow Exhibition Motor Trials. Illustrates and describes many of the competing vehicles. Also editorial. 14000 w. Auto Jour—Sept., 1901. No. 43399 A.

The Glasgow Autocar Trials. Particulars of the trials and competing vehicles, with illustrations. 2800 w. Autocar—Aug. 31, 1901. No. 43129 A.

The Motor Vehicle Durability Trials. Brief account of these trials, made with the object of testing the durability of the vehicles, with report of the results. 1800 w. Engr, Lond—Sept. 13, 1901. No. 43349 A.

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Motor Cycle.

A New Motor Cycle. Illustrated description of an English invention, in which the motor is embraced by the back wheel. 1200 w. Sci Am—Sept. 28, 1901. No. 43381.

Mowing Machine.

Gasoline Motor Mowing Machine (Faucheuse Automobile à Pétrole). G. Coupan. Illustrated description of the Deering automobile mowing machine as exhibited at Plessis, near Châteauroux, France. 1200 w. 1 plate. Génie Civil—Aug. 31, 1901. No. 43404 D.

Newport Races.

The Newport Automobile Races. An illustrated account of the races at Newport, R. I. 600 w. Sci Am—Sept. 14, 1901. No. 43200.

Steam Carriage.

The Clarkson Steam Carriage and Kerosene Burner. Illustrated description of a design by an English engineer showing considerable deviation from American practice. 2000 w. Horseless Age—Sept. 4, 1901. No. 43104.

Touring Vehicle.

The Larchmont Motor Company's Touring Vehicle for the Endurance Run. Illustrated detailed description. 1600 w. Horseless Age—Sept. 11, 1901. No. 43179.

Variable Speed.

The de Moutais Speed-Changing Device. Half-tone and line engravings, with description of a device adapted particularly to automobile purposes. 700 w. Am Mach—Sept. 26, 1901. No. 43374.

HYDRAULICS.

Flow.

Comparison of Formulas for Flow of Water in Clean Cast-Iron Pipes. Letters from John C. Trautwine, Jr., E. Sherman Gould and Frank S. Bailey, discussing the difficulty of determining a constant coefficient for the flow of water in pipes. Aug. 15. 2700 w. Eng News—Sept. 12, 1901. No. 43195.

Hydraulic Plant.

Hydraulic Plant. An illustrated article, giving particulars of a plant from the laying of the foundation to the testing of the engines, calling attention to important points. 1000 w. Prac Engr—Aug. 23, 1901. No. 43019 A.

Pitot Tube.

The Pitot Tube: Its Formula. William Monroe White. Describes interesting experiments made by the author, discussing the laws governing the flow of water, and the diversity of opinion as to the formula of the Pitot tube. Discussion follows. Ill. 12000 w. Jour Assn of Engng Soc's—Aug., 1901. No. 43287 C.

Plumbing.

Plumbing in the Lying-In Hospital, New York. Illustrated description of the special features of plumbing work in a hospital where unusual precautions were taken to have no seams or corners in which dust can collect. 1800 w. Eng Rec—Sept. 7, 1901. No. 43128.

Pumping.

See Electrical Engineering, Power Applications.

Pump Rig.

A Farm Pump Rig. F. A. Stanley. Brief illustrated description of a simple arrangement for pumping water. 400 w. Am Mach—Sept. 5, 1901. No. 43099.

Ram Pump.

Pearn's Compound Single-Acting Ram Pump. Brief illustrated description. 400 w. Engng—Sept. 13, 1901. No. 43346 A.

Turbines.

Recent Turbine Installations (Neuere Turbinenanlagen). Giving descriptions of recent installations by Escher, Wyss & Co., at Schaffhausen, Chèvres, Lyons, Niagara, and Kubel. Two articles. 4000 w. 1 plate. Zeitschr d Ver Deutscher Ing—Aug. 24, 31, 1901. No. 43414 each D.

Water-Wheels.

The Cassel Self-Regulating Water Wheel. E .C. de Segundo. Illustrates and describes this wheel explaining its action. 2100 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43284 D.

MACHINE WORKS AND FOUNDRIES.

Brace Pins.

On the Strength of Brace Pins. Discusses the different modes of failure, and the way to compute the diameter of a brace pin for a boiler staybolt. Ill. 1500 w. Locomotive—Aug., 1901. No. 43383.

Cast-Iron.

Physical Development of Malleable Cast Iron. C. Powers. Discusses the elements that effect physical standards, and the conditions to overcome. 3000 w. Foundry—Sept., 1901. No. 43048.

Coining.

How Money Is Made. Marcus Benjamin. A brief summary of the principal steps in transforming ore into coin. Ill. 2000 w. Sci Am—Sept. 7, 1901. No. 43108.

Cost-Keeping.

See Industrial Economics.

Cranes.

See Electrical Engineering, Power Applications.

Dies.

Dies for Making a Street Metal Ferrule. William Doran. Illustrates and describes

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dies which produce in two operations results which would usually require four. 2500 w. Am Mach—Sept. 19, 1901. No. 43322.

Engraving.

An Engraving Machine. Illustrated descriptions of a machine of English origin, used for this work. 500 w. Am Mach—Sept. 26, 1901. No. 43375.

Foundry Work.

Opportunities for Bettering the Work of the Foundry. Percy Longmuir. States conditions as they often exist, showing that poor installations are costly, and discussing points leading to satisfactory and economical results. 3800 w. The Engineering Magazine—Oct., 1901. No. 43484 B.

Gas Brackets.

Some Adjustable Gas-Brackets for Work-Shop Use. Illustrates and describes fittings manufactured in German shops. 1300 w. Jour Gas Lgt—Sept. 3, 1901. No. 43174 A.

Grinder.

The Bath Upright Type Universal and Combination Grinder. Illustrated detailed description. 1500 w. Ir Age—Sept. 5, 1901. No. 43060.

Index Table.

Complete Index Table for the Universal Milling Machine. Theo. J. Schmitz. Gives table complete for all whole numbers up to 360 divisions, which may be used for the usual method of indexing and the De Leeuw method. 500 w. Am Mach—Sept. 5, 1901. No. 43102.

Jigs.

The Jig Habit in America. Oberlin Smith. Discusses the tendency to use jigs and analogous tools for the accurate and rapid development of interchangeable parts of machines. 2800 w. Jour Fr Inst—Sept., 1901. No. 43058 D.

Metric System.

The Adoption of the Metric System in Our Work-Shops. Arthur Greenwood. Urging the adoption of the system. 2000 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43281 D.

See Civil Engineering, Measurement.

Moulding.

Moulding a Special Casting. George Buchanan. Illustrates and describes the work. 600 w. Am Mach—Sept. 26, 1901. No. 43377.

Pig Iron.

Machine Cast-Foundry Pig Iron. Albert Ladd Colby. Read before the Philadelphia Foundrymen's Assn. On the application of machine casting to foundry pig, the advantages, and difficulties, attending its introduction. Ill. 4500 w. Ir Age—Sept. 12, 1901. No. 43153.

Plows.

Cast and Chilled Plows. R. L. Ardrey. Reviews the history of this implement in America, giving an account of Juthro Wood's success with the cast plow, and James Oliver's with the chilled plow. 3000 w. Ir Age—Sept. 5, 1901. No. 43063.

Pneumatic Tools.

Pneumatic Riveting, and Other Useful Applications. J. C. Taite. An illustrated article confined principally to the work of riveting. 2200 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43277 D.

Power Press.

The Power Press in Agricultural Machine Work. William Doran. Illustrated account of work done by the power press, especially in punching heavy stock. 1900 w. Am Mach—Sept. 12, 1901. No. 43185.

Premium System.

See Industrial Economics.

Punch.

An Expansion Punch. Jos. V. Woodworth. Illustrates and describes a punch used for producing a bead on the outside of a straight drawn shell, and its operation. 1400 w. Am Mach—Sept. 5, 1901. No. 43100.

Shearing.

Shearing with Circular Shears (Cisaillage avec Lames Circulaires). M. Codron. A continuation of the author's investigation of the work of machine tools. The power required to shear various metals was determined by bell, hydraulic, steam, and electric driving. 8000 w. Bull Soc d'Encour—Aug. 31, 1901. No. 43429 G.

Sheet-Metal.

A Job of Piercing, Blanking and Forming Sheet Metal. William Doran. Illustrated description of the punch and dies used and their construction. 1700 w. Am Mach—Sept. 5, 1901. No. 43098.

Shop Methods.

Modern Systems for Shop Work. W. H. Booth. Discusses the practice in British workshops, defending its good qualities and pointing out its mistakes and where improvements are needed. 2200 w. Elec Rev, Lond—Aug. 23, 1901. No. 43026 A.

Special Methods for Machine Shop Operations (Verfahren zur Bearbeitung von Maschinenkörpern). E. Capitaine. With details of various convenient machining operations as conducted in the writer's establishment; including drilling, milling, and shaping special pieces. 2000 w. Zeitschr d Ver Deutscher Ing—Aug. 24, 1901. No. 43416 D.

Workshop Methods. William Weir and J. R. Richmond. Gives an account of schemes inaugurated to interest the staff and men of an engineering establishment

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in securing greater efficiency. 3300 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43276 D.

Slide Valves.

The Inertia of a Slide Valve. J. E. Cooper. Deals with the stresses caused by the reciprocating motion, and considers the best means of providing for them. 1500 w. Prac Engr—Aug. 23, 1901. No. 43020 A.

MATERIALS OF CONSTRUCTION.

Alloys.

Alloys of Lead and Tellurium. Henry Fay and C. B. Gillson. Concerning investigations carried out at the Inst. of Technology, Boston. Ill. 3500 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43298 D.

Notes on Alloys of Copper and Iron. J. E. Stead. Abstract of paper read before the Glasgow Congress. Report of researches made during the last year, giving results. 5500 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43250 A.

Brasses.

Brasses. Percy Longmuir. Gives interesting information concerning the varieties of brass, the composition, treatment, etc. 1800 w. Foundry—Sept., 1901. No. 43047.

Brittleness.

The Brittleness of Steel (Sur la Fragilité de l'Acier). A. Pourcel. A review of the experiments of Frémont on bending tests of small nicked bars. 3000 w. Génie Civil—Aug. 17, 1901 No. 43-400 D.

Flat-Wire.

Producing Flat Wire of Uniform Gauge. A. F. Horton. Illustrates and describes method. 1000 w. Am Mfr—Aug. 29, 1901. No. 42998.

Hardness.

Brinell's Method of Determining the Hardness and Other Properties of Iron and Steel. Axel Wahlberg. Abstract of a paper read before the Glasgow Congress. Considers the influence of chemical composition of freezing temperatures, of notches in the specimens, and of treatment. 3300 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43247 A.

Nickel Steel.

The Industrial Applications of Nickel Steel. Charles Edouard Guillaume. Gives results of the author's original work and gives predictions of their future extended applications. 3800 w. The Engineering Magazine—Oct., 1901. No. 43486 B.

Oils.

Practical Testing of Oils for Gas and Fuel Purposes. L. P. Lowe. Read before the Pacific Coast-Gas Assn. Also discussion. Concerning practical means of determining the degree of purity, and the importance of systematic inspection. 4700 w. Am Gas Lgt Jour—Sept. 9, 1901. No. 43152.

Taylor-White Process.

The Taylor-White Process of Treating Tool Steel, and Its Influence on the Mechanic Arts. Charles Day. Briefly describes the process and gives an account of the work in the shops of the Link-Belt Engng. Co., Philadelphia. 5200 w. Jour Fr Inst—Sept., 1901. No. 43055 D.

Testing Machines.

The 100-Ton Universal Testing Machine, with Variable Accumulator, at the James Watt Laboratories, Glasgow University. J. Hartley Wicksteed. Illustrated detailed description. 1900 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43283 D.

Treatment.

The Correct Treatment of Steel. C. H. Risdale. Abstract of a paper read at Glasgow Congress. Gives the writer's views, discussing the responsibility of the maker and user tests, etc. 1100 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43251 A.

Wire-Making.

The Effect of Copper on Steel for Wire-Making. J. E. Stead and F. H. Wigham. Abstract of a paper read before the Glasgow Congress. Gives analysis and a summary of the results of the author's work. 1900 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43245 A.

POWER AND TRANSMISSION.

Air Compressor.

A High Duty Air Compressor Driven by the Largest Pelton Wheel in the World. Describes arrangements at the Morning Mine, Idaho, for furnishing power for mining operations. Ill. 900 w. Am Mach—Sept. 26, 1901. No. 43376.

Driving Plant.

Power Required to Drive a Marine-Engine Works. James Crighton and W. G. Riddell. Illustrated description of some recent improvements and report of results. 2400 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43282 D.

Handling.

The Handling of Merchandise (Der Bewegung von Massengütern). A. Lemmer. Presidential address before the Kiel meeting of the Verein deutscher Ingenieure, discussing especially modern methods of handling grain cargoes. 2500 w. Zeitschr d Ver Deutscher Ing—Aug. 24, 1901. No. 43415 D.

Mechanical Conveying.

Mechanical Conveying of Coal and Coke in Gas-Works. Henri Laurain. Read at

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meeting of the Société Technique. Considers the hauling of the coal to the retorts and the mechanical conveying of the coke from the retorts, giving illustrations of the De Brouwer apparatus. 3800 w. Jour Gas Lgt—Sept. 3, 1901. No. 43173 A.

The Mechanical Transport of Materials in Gas-Works. William Reginald Chester. Describes the apparatus in use for transporting coal, coke, purifying material, and sulphate of ammonia. 2200 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43256 A.

Pan-American.

The Power Plants of the Pan-American Exposition. Illustrated detailed description of the sources of power for the exposition. 3300 w. Power Qr—Sept., 1901. No. 43313 C.

Traction Plant.

Compressed Air Traction Plant, Red Point Mine, Placer County, Cal. Outlines the method of mining in this gold placer. It is a horizontal deposit beneath a volcanic deposit, and the drift mining method consists in driving tunnels. Describes the traction installation. Ill. 1300 w. Min & Sci Pr—Aug. 31, 1901. No. 43103.

Variable Speed.

Variable Speed Transmitters Illustrates and describes three new devices for the positive transmission of variable speed. 2800 w. Mach. N. Y.—Sept., 1901. No. 42099.

SPECIAL MOTORS.

Alcohol.

Alcohol Motors (Les Moteurs à Alcohol). L. Périssé. An exhaustive study of the construction and operation of internal combustion motors using alcohol as fuel. 15000 w. Mem Soc Ing Civ de France—July, 1901. No. 43418 G.

Binary Engine.

The Waste-Heat Auxiliary Engine. Illustrates this engine that has been in service during the past three months at the central station of the Berlin Electrical Works, reporting the results of the tests and its standing as an economic factor in the generation of power. 2300 w. U. S. Cons Repts, No. 1139—Sept. 14, 1901. No. 43178 D.

Diesel Motor.

The Diesel Thermal Motor (Mittheilungen über den Thermischen Motor, System Diesel). R. Diesel. An address reviewing the progress of the Diesel motor, showing especially its advantages in an oil producing country as to commercial as well as thermal economy. Two articles, 8000 w. Zeitschr d Oesterr Ing u Arch Ver—Sept. 6, 13, 1901. No. 43424 each B.

Gas Engines.

Gas Engines at the Pan-American Exposition. An illustrated description of the internal combustion engines in the pumping plant, in the court of the Machinery and Transportation Building and on exhibiton. 4500 w. Engr, U. S. A.—Sept. 15, 1901. No. 43319.

Gas Engines at the Pan-American Exposition. Illustrates and describes the engines taking part in the power supply for the exposition. 4800 w. Power—Sept., 1901. No. 43092.

Gas, Gasoline and Alcohol Motors at the Exposition of 1900 (Les Moteurs à Gaz, à Pétrole, et à Alcool à l'Exposition de 1900). G. Lavernge. The first instalment of a general description of the motors shown at the Paris Exposition. Serial. Part I. 1800 w. Génie Civil—Aug. 17, 1901. No. 43401 D.

The Buffalo Tandem Gas Engine. Illustrated description, noting the distinctive features. 1500 w. Ir Age—Sept. 5, 1901. No. 43062.

Oil Motors.

The Application of Oil Motors to Marine Work. The first of a series of articles, discussing the advantages and disadvantages of these motors. The present number considers the application to launches. 3400 w. Prac Engr—Aug. 23, 1901. Serial. 1st part. No. 43018 A.

Power Gas.

An Examination of Various Power Gases (Einiges über die zur Krafterzeugung Verwendeten Gasarten). F. Krull. An examination of the various producer and water gas processes and the relative values of the products for motive power. 2500 w. Zeitschr d Oesterr Ing u Arch Ver—Aug. 30, 1901. No. 43423 B.

The Utilisation of Blast Furnace Gases (L'Utilisation des Gaz de Haut Fourneau). J. Deschamps. A general review of the development of power by the use of furnace gases in internal combustion motors, from the first experiments of Thwaite to the present time. Mem Soc Ing Civ de France—July, 1901. No. 43419 G.

The Loomis Water-Gas and Producer-Gas Process. Illustrates and describes a plant recently installed at the works of the Winchester Repeating Arms Co., New Haven, Conn. 1700 w. Eng News—Sept. 12, 1901. No. 43190.

The Profitable Utilization of Power From Blast-Furnace Gases. B. H. Thwaite. An explanation of the system and a statement of its advantages. 1100 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43246 A.

STEAM ENGINEERING.

Blowing Engine.

Compound Blowing Engine at the As-

kam Iron Works. Illustrates and describes the engine and its operation. 1200 w. Engng—Sept. 13, 1901. No. 43345 A.

Boilers.

Discussion on Mr. G. M. Brown's Paper on "Some Attempts to Increase the Efficiency of Marine Boilers." 7000 w. Trans of N.-E. Coast Inst of Engrs & Shipbuilders—May, 1901. No. 42986 E.

Mr. G. M. Brown's Reply to the Discussion on His Paper on "Some Attempts to Increase the Efficiency of Marine Boilers." 1600 w. Trans of N.-E. Coast Inst of Engrs & Shipbuilders—July, 1901. No. 42990 E.

Resumed Discussion on Mr. E. Griffith's Paper on "Water-Tube Boilers." Also plates. 9600 w. Trans of N.-E. Coast Inst of Engrs & Shipbuilders—July, 1901. No. 42991 E.

The Lagosse Boiler (Les Chaudières Lagosse). With details of tests showing an evaporation of more than 10 pounds of water per pound of combustible. The device is a combined shell and water-tube boiler. 2000 w. Revue Technique—Aug. 25, 1901. No. 43412 D.

The Niclausse Boiler (Niclausse Kessel). Carl Züblin. A review of the development of the Niclausse boiler, with special reference to the marine type, giving details of construction, automatic feed, etc. Serial, Part I. 4000 w. 1 plate. Schiffbau—Sept. 8, 1901. No. 43438 D.

The Working Economy of the Steam Boiler. Charles Arthur Hague. A discussion of the disagreement of expert tests and service conditions. 4000 w. The Engineering Magazine—Oct., 1901. No. 43487 B.

Water-Tube Boilers. Edwin Griffith. Considers the present position of water-tube boilers from the point of view of the marine engineer. Also appendix, discussion and plates. 16000 w. Trans of N.-E. Coast Inst of Engrs & Shipbuilders—May, 1901. No. 42989 E.

Boiler Explosions.

The Boiler Explosions at Sardinia Street Station. Substance of the Board of Trade report concerning these explosions which took place last winter. The boiler was of the water-tube type. Ill. 7500 w. Elect'n, Lond—Sept. 6, 1901. No. 43213 A.

Brewery Plant.

Steam Heating and Ventilating Plant of the Liesing Brewery J. H. Klinger. Translated from *Gesundheit's Ingenieur.* Illustrated description of the building and of the steam-heating plant and the ventilating plant. 1500 w. Dom Engng—Sept. 15, 1901. No. 43316 C.

Engine Test.

Test of a Steam Engine (Expériences sur une Machine à Vapeur). J. Hirsch. A detailed account of the elaborate test by Professor Hirsch of the improved steam engine of MM. Weyher & Richemond. Serial, Part I. 5000 w. Revue de Mécanique—Aug. 31, 1901. No. 43427 E + F.

Exhaust Steam.

Note on a Regenerative Accumulator and Its Application for Using Exhaust Steam. M. A. Rateau. Illustrates and describes a new apparatus intended to allow the use of exhaust steam from machines having intermittent action, such as winding engines or the reversible engines of rolling mills. 700 w. Inst of Mech Engrs —Glasgow Congress, 1901. No. 43274 D.

Expansion.

The Expansion of Steam. O. P. St. John. Presented before the Canadian Assn. of Stationary Engrs. Discusses the laws governing expansion and their results as affecting the efficiency. 2900 w. Engr, U. S. A.—Sept. 1, 1901. No. 43075

Fuel.

Pulverized Fuel. R. A. Douglass. On the preparation of this fuel and methods of burning, the advantages claimed, etc. 2400 w. Am Elect'n—Sept., 1901. No. 43066.

Furnaces.

Furnace Temperatures. W. H. Booth. Discusses points in the combustion of bituminous fuels. 2500 w. Elec Rev, Lond —Aug. 30, 1901. No. 43131 A.

Heat.

Wasted Heat. A. M. Wickens. Discusses some points relating to economical combustion. 1600 w. Can Engr—Sept., 1901. No. 43082.

Indicator Diagrams.

Some Shop Engine Indicator Diagrams. C. D. King. Gives a set of diagrams taken on a cross-compound Corliss engine, with explanatory notes. 600 w. Am Mach—Sept. 5, 1901. No. 43101.

Theoretical Indicator and Valve Diagrams and Their Relation to Marine Engine Design. Theodore Lucas. Explains the great value of diagrams to engine designers in settling rapidly and efficiently many points to be considered. Ill. 1500 w. Marine Engng—Sept., 1901. No. 43070 C.

Lubrication.

A Lubrication Regulator. From *La Nature.* Illustrates and describes an apparatus designed by M. Caloin, giving automatic lubrication for the entire engine, and possessing many advantages. 1100 w. Sci Am Sup—Sept. 21, 1901. No. 43326.

Marine Engines.

Some Facts Affecting the Economical Manufacture of Marine Engines. William

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Thomson. Considers the premium system, good tools, arrangement, shop conditions, and standardization. 3200 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43-275 D.

Orifices.

Experiments on the Escape of Steam Through Orifices. M. A. Rateau. An illustrated report of results obtained in experimental investigations. 1100 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43272 D.

Petroleum.

Petroleum as Fuel. From an article by A. Adiassewich in *Fairplay*. Gives some reasons why it can be regarded as a competitor of coal, experimental determinations of its heating value, etc. 2000 w. Marine Rev—Sept. 5, 1901. No. 43116.

Steam Heating.

Systems of Heating by Steam. H. H. Kelley. Illustrated description of the various systems of steam heating employed in buildings and residences. 2500 w. Engr. U. S. A.—Sept. 1, 1901. Serial. 1st part. No. 43076.

Steam Meter.

The Gehre Steam Meter (Compteur de Vapeur, Système Gehre). Ch. Dantin. A description of the Gehre Meter for measuring the flow of steam by regulating the opening, according to Napier's law. A recording attachment is included. 2000 w. Génie Civil—Aug. 31, 1901. No. 43-406 D.

Steam Plant.

The Steam Plant in the Atlantic Mutual Building, New York. Illustrated description of the power plant in an 18-story office building, giving details of the machinery, extracts from the specifications, and general features of the electrical installation. 5000 w. Eng Rec—Sept. 7, 1901. No. 43121.

Steam Tables.

Steam Tables. Charles L. Hubbard. Explains some of the principles of heat and steam and the application of steam tables to practical examples in engineering. 2500 w. Am Elect'n—Sept., 1901. No. 43065.

Steam Turbines.

Trials of Steam Turbines for Driving Dynamos. Charles A. Parsons, and G. Gerald Stoney. Tabulated results of tests are given, with illustrations and description of latest improvements. 2200 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43273 D.

Superheating.

Superheated Steam. O. Herre. Explains the manner of superheating, and gives tabulated information showing the economy effected. 800 w. Power—Sept., 1901. No. 43091.

Some Experiences and Results Derived From the Use of Highly Superheated Steam in Engines. R. Lenke. 2300 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43278 D.

The Schmidt System of Superheating Steam. Illustrates and describes the Schmidt patent "direct-fired" superheater, and the flue-fired superheater. Also the Schmidt single-acting tandem compound condensing engine. 2800 w. Ir & Coal Trds Rev—Aug. 30, 1901. No. 43135 A.

Water Columns.

Water Column Connections. C. W. Obert. An account of the results of false practice in method of connecting up water columns for steam gauge and water-glass connection to boilers. 600 w. Am Elect'n—Sept., 1901. No. 43068.

MISCELLANY.

Address.

The Art and Craft of the Machine. Frank Lloyd Wright. The address deals chiefly with the effect of the machine on architecture, and that it should be made evident that it is a help in the line of progress to the very best work possible for men. 9000 w. Jour W Soc of Engrs—Aug., 1901. No. 43053 D.

Agricultural Machinery.

Agricultural Machinery in the Canadian Pavilion at the Glasgow International Exhibition, 1901. G. Harwood Frost. Illustrated descriptions of harrows, cultivators, harvesters, mowers, etc., etc. 7000 w. Inst of Mech Engrs—Glasgow Congress, 1901. No. 43271 D.

Bicycles.

Bicycle Construction (Les Bicyclettes). C. Bourlet. The first of a series discussing "free" wheels, brakes and variable speed gears for bicycles. Serial, Part I. 1500 w. Génie Civil—Sept. 7, 1901. No. 43-408 D.

Church Heating.

Ventilating and Heating St. Mark's Church, Baltimore. The hot air is distributed under a plenum system assisted by aspiration near the exits. The ventilation is an upward one with air delivery through a large number of small openings in the ends of the various pews. Ill. 1800 w. Eng Rec—Sept. 14, 1901. No. 43269.

Enamelling.

Enamelling. The first of a series of articles on the commercial enamelling industry, considering hollow-ware enamelling for domestic use, and for chemical use, enamelling locomotive and other tubes,

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drain and water pipes, and sign-board enamelling. 4200 w. Engr. Lond—Aug. 23, 1901. Serial. 1st part. No. 43041 A.

Glasgow.

The Rise and Progress of Glasgow Industries. A review of the more important industries of the city. 5000 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43234 A.

Guns.

New 5-Inch Segmental Wire-Wound Gun for the United States Army. Illustrates and describes the process of manufacture, and gives information of interest. Also editorial. 3200 w. Sci Am—Sept. 7, 1901. No. 43107.

Heating Plant.

Ventilation and Heating in the Merchants' Loan and Trust Building, Chicago. Describes the plant of a 12-story office building. It is warmed by steam, distributed by means of the downward system of piping with gravity return; a vacuum system of circulation and automatic temperature regulation, and ventilated in the lower stories by a plenum and exhaust system. Ill. 2700 w. Eng Rec—Sept. 21, 1901. No. 43370.

Ice Plant.

A Model Ice-Making Plant. Illustrated description of a plant in Waynesboro, Pa. 1200 w. Ice & Refrig—Sept., 1901. No. 43085 C.

Kinematics.

The General Principles of Mechanism (Sur les Principes Généraux des Mécanismes). G. Koenigs. A communication to the French Academy, criticising some details of the kinematic analysis of machines by Prof. Reuleaux. 1200 w. Comptes Rendus—Aug. 19, 1901. No. 43431 D.

Refrigeration.

The Ammonia Compression System. T. F. Andersen. Abstract of a lecture before Illinois No. 28. Discusses points of importance in securing economy and efficiency. 2200 w. Compressed Air—Sept., 1901. No. 43286.

School Heating.

Ventilation and Heating of Friendship School, Pittsburg. Illustrated description of an unusually costly plant taking air from an inlet 60 ft. from the building and avoiding the use of galvanized ducts in the basement by employing underground flues. 1500 w. Eng Rec—Sept. 7, 1901. No. 43126.

MINING AND METALLURGY

COAL AND COKE.

Briquettes.

Lignite and Peat Briquettes in Germany. Concerning the efforts made to utilize the turf beds with an account of the Stauber process of making briquettes. 700 w. U. S. Cons Repts, No. 1142—Sept. 21, 1901. No. 43310 D.

Brown Coal.

The Brown Coal Industry of Germany and Austria. A résumé of the report of James Stirling, giving information of the principal mining areas in the countries named. Ill. 3700 w. Ir & Coal Trds Rev—Aug. 23, 1901—No. 43032 A.

By-Products.

The Development of the By-Product Coking Industry. William Gilbert Irwin. An illustrated article reviewing the systems evolved in Europe and recently in America. 5200 w. The Engineering Magazine—Oct., 1901. No. 43483 B.

China.

The Coal-Fields of Northeastern China. Noah Fields Drake. An account of the K'ai-p'ing, P'ing-Ting and Tsê Chou fields, with general remarks and illustrations. 5600 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 43290 D.

Coal Developments.

Anglo-Chinese Coal Developments. Editorial on the transfer of the Kai-ping coal mines in Northern China, from a native to an English company, and the immense deposits. 1200 w. Engng—Aug. 23, 1901. No. 43037 A.

Coke-Making.

Coke-Making at the Olion Coke-Works. Fred C. Keighley. Illustrates and describes these works in Pennsylvania. 2200 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43252 A.

Germany.

The General Coal Industry: Syndicates and Government Mines. Discusses the questions relating to this industry which are being considered. The new tariff, etc. 2000 w. Col Guard—Aug. 30, 1901. No. 43139 A.

Haulage.

Adjustable Turntable for Haulage Inclines. From *Glückauf*. Drawings and description of an arrangement introduced to overcome the difficulties attending the switching of tubs in and out of haulage inclines. 7000 w. Col Guard—Aug. 30, 1901. No. 43138 A.

Origin.

The Origin of Coal. Reviews the theory set forth by Aubrey Strahan in a paper read at a meeting of the Geol. Soc. 1400 w. Engng—Aug. 23, 1901. No. 43034 A.

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Subsidences.

Coal-Mining Subsidences in Relation to Sewerage Works. F. W. Mayer. Directs attention to the irregular nature of the protection against subsidencies from mining operations. 1000 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43255 A.

Surface Plant.

Coal Tipple and Cantilever Bridge Over Tygart's Valley River, Near Fairmont, W. Va. Illustrates and describes details of a new surface plant for operating coal mines. 900 w. Eng News—Sept. 19, 1901. No. 43329.

Wages.

See Industrial Economics.

Washing.

Coal Washing. D. F. Cameron. An illustrated description of the coal-washing plant of the Donk Brothers Coal & Coke Co., at Collinsville. Ill. 3800 w. Mines & Min—Sept., 1901. No. 43094 C.

West Lothian.

The Carboniferous Limestone Coal-Fields of the West Lothian. Henry M. Cadell. Abstract of a paper read before the Glasgow Congress. Describes the seams and gives diagrams. 1200 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43253A.

Winding.

Reserve Winding Gear at German Collieries. From *Zeitschrift für Berg. Hutten und Salinenwesen.* Illustrates and describes arrangements erected to ensure continuity of coal-raising in the event of accident to the main winding gear. 600 w. Col Guard—Aug. 30, 1901. No. 43-137 A.

COPPER.

Arizona.

Arizona Copper. Joseph Hyde Pratt. An illustrated article. Part first deals with the general occurrences. 2500 w. Min & Met—Sept. 1, 1901. Serial. 1st part. No. 43079.

Developments.

Copper Developments. Editorial discussion of the present situation and future outlook, and the steps being considered to maintain the price of this product. 1100 w. Engng—Aug. 23, 1901. No. 43035 A.

Japan.

The Copper Mines of Ashio, Japan. Edwin G. Adams, Jr. An illustrated article showing the effect of abandoning the old methods and the rapid increase of production under native engineering management. 1500 w. The Engineering Magazine—Oct., 1901. No. 43485 B.

GOLD AND SILVER.

Africa.

African Mines and Mining. Arthur Stanley Riggs. An illustrated account of the gold, diamond and other mineral fields, and the mining industry in general. 3500 w. Min & Met—Sept. 1, 1901. No. 43-078 C.

Alaska.

Ketchikan Mining District, Alaska. An account of this region describing the mines already located. Copper, gold, lead and silver are found. Map. 8500 w. Min & Sci Pr—Sept. 7, 1901. No. 43159.

Georgia.

The Crown Mountain Gold Mine and Mill, Georgia. Henry V. Maxwell. Illustrates and describes a plant combining the old and new methods in mining and saving the gold contents of low-grade ores. It combines mining, milling and sluicing, and utilizes water-power in generating and transmitting electrically the power needed. 1200 w. Eng & Min Jour—Sept. 21, 1901. No. 43359.

Gold Dredging.

Dredging for Gold in New Zealand. Raymond Payne. An illustrated account of the methods and success attained. 1900 w. Eng & Min Jour—Sept. 28, 1901. No. 43391.

Gold-Dredging Possibilities on the North Thompson River Near Kamloops, B. C. John Redmond. Discusses the possibility of profitable dredging. 2000 w. B. C. Min Rec—Sept., 1901. No. 43176 C.

Ore Deposits.

The Sierra Mojada, Coahuila, Mexico, and Its Ore-Deposits. James W. Malcolmson. Gives the history and development of the Sierra Mojada mines, the character and extent of the ore-deposits, and the methods of mining. Ill. 10600 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43296 D.

Ore Treatment.

Ore Treatment in Victoria. Donald Clark. Illustrates and describes the South German cyanide plant at Maldon. 1800 w. Aust. Min Stand—Aug. 8, 1901. No. 43146 B.

Philippines.

Notes on the Pigholugan and Pigtao Gold-Regions, Island of Mindanao, Philippine Islands. J. Clayton Nichols. Descriptive. 2200 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43300 D.

Rhodesia.

Mining in Rhodesia. Cyril E. Parsons. Reviews the conditions and present output of this gold field. 1100 w. Eng & Min Jour—Aug. 31, 1901. No. 43002.

Sampling.

Sampling Mill Work. Jesse Scobey. Discusses prevalent systems, and the importance of the records, describing a meth-

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od devised by the writer. 2100 w. Min & Sci Pr—Sept. 21, 1901. No. 43387.

IRON AND STEEL.

Bessemer Flames.

An Investigation of the Spectra of Flames at Different Periods During the Basic Bessemer Blow. W. N. Hartley and Hugh Ramage. Abstract of a paper read before the Glasgow Congress. Gives description of the blow and over-blow, the spectrum of the over-blow, and conclusions. 4500 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43244 A.

Canada.

Iron and Steel Making in Ontario, Canada. Reviews the recent development of this industry, and describes some of the plants. 3400 w. Ir & Coal Trds Rev—Aug. 23, 1901. No. 43031 A.

Ferro-Alloys.

The Presence of Calcium in High Grade Ferro-Silicon. G. Watson Gray. Abstract of a paper read before the Glasgow Congress. Gives analysis of ferro-silicons containing calcium, describing work. 1500 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43243 A.

Internal Strains.

The Internal Strains of Iron and Steel and Their Bearing Upon Fracture. Arthur Wringham. Abstract of a paper read before the Glasgow Congress. Studies the behavior of metals and unexpected breakages. 5600 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43249 A.

Japan.

The Japanese Iron Industry. An illustrated description of the smaller works in Japan, producing iron and steel in the old fashioned way and which has furnished the famed sword steel of the Japanese. 1000 w. Col Guard—Sept. 6, 1901. No. 43220 A.

Pig Iron.

A Crystalline Sulphide in Pig-Iron. Andrew A. Blair and Porter W. Shriner. Describes investigations to isolate a suspected insoluble sulphide. 800 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 43293 D.

The Cost of Producing Pig Iron in the United States. William B. Phillips. Discusses the cost in various districts and compares the results with foreign countries. 2500 w. Eng & Min Jour—Aug. 31, 1901. No. 43003.

Rod Mill.

Emciency Test of a Continuous Rod Mill. Describes the plant and test of a Morgan continuous rod mill. Ill. 2000 w. Ir Age—Sept. 12, 1901. No. 43154.

Scotland.

Iron and Steel Industries of the West of Scotland. I. Henry Burnby. II. William Wylie. Discusses pig and malleable iron industries, the materials, bye-products, etc. 4500 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43242 A.

Slag.

Disintegrating Blast Furnace Slag. A. D. Elbers. Explains the phenomenon of slag disintegrating by its own heat. 1800 w. Am Mfr—Sept. 5, 1901. No. 43110.

Steel Billets.

Variations of Carbon and Phosphorus in Steel Billets. Axel Wohlberg. Abstract of paper read before the Glasgow Congress. Gives the plan of the researches, the results and conclusions. 2800 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43248 A.

MINING.

Boring.

Deep Borings at the Rheinpreussen Mine (Tiefbohrverfahren der Zeche Rheinpreussen). H. Mentzel. With description of the machines and table of the borings at the Rheinpreussen mine, near Homberg. 1000 w. 1 plate. Glückauf—Aug. 31, 1901. No. 43461 B.

Mechanics of Oil Well Boring. A brief analysis of the arts of well-boring and related matters, describing systems used in America. Ill. 1500 w. Am Gas Lgt Jour—Sept. 23, 1901. No. 43363.

Colorado.

The Tragedy of the Homestake Mine, Colorado. W. H. C. Butler. Historical account of the discovery and early working. Ill. 1500 w. Min Rept—Sept. 19, 1901. Serial. 1st part. No. 43354.

Concentration.

Concentrating Systems. Editorial remarks on methods to meet the requirements of different districts and special ores. 1500 w. Eng & Min Jour—Sept. 14, 1901. No. 43181.

Concentrating Zinc-Lead Ores in the Galena Joplin District of Missouri. W. R. Crane. Describes the methods of milling and separating the pyrites. Ill. 2000 w. Mines & Min—Sept., 1901. No. 43096 C.

The Waring System of Magnetic Concentration. Outlines the five types of magnetic separators that have been tried, and gives an illustrated description of the system named. It is in use for the purification of zinc blende ores, the extraction of blende from pyritic jig stuff, and for the separation of pure zinc, copper and iron material from complex sulphide ores. 2000 w. Eng & Min Jour—Sept. 14, 1901. No. 43184.

Diamond Drill.

Electrically Driven Diamond Drill (Perforatrice à Diamants et à Commande Elec-

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trique). An illustrated description of the Fromholt electric drill for mining, quarrying, and tunnelling. 1200 w. Génie Civil —Sept. 7, 1901. No. 43410 D.

Emergency Valve.

A New Emergency Straightway Gate Valve. A. F. Lucas. Illustrated description of a valve used in closing an oil well near Beaumont, Texas. 600 w. Eng & Min Jour—Sept. 21, 1901. No. 43360.

Explosives.

Annual Report on Explosives. Extracts from the report of the Inspectors of Explosives for the year 1900. 2200 w. Engr, Lond—Aug. 23, 1901. No. 43042 A.

Firedamp.

Firedamp Explosions on the Surface (Schlagwetterexplosionen über Tage). H. Einecker. An account of an explosion of fire damp on the surface of the earth, being in the washing tower of the Dahlbusch colliery near Ratthausen, East Essen. 1200 w. Glückauf—Aug. 17, 1901. No. 43457 B.

Galena-Joplin District.

Methods of Prospecting and Mining in the Galena-Joplin District. W. R. Crane. Discusses the character and origin of the deposits; the prospecting by shafts and by drills; method of mining, with details; and method of drifting. 4000 w. Eng & Min Jour—Sept. 21, 1901. No. 43362.

"Hole Contract."

The Operation of the "Hole Contract" System in the Center Star and War Eagle Mines, Rossland, B. C. Carl R. Davis. Explains why the system was introduced, the details, advantages and disadvantages of the system. 2200 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43294 D.

Mining Report.

Mining Labor and Accidents for the Year 1900. Part II. of Dr. Foster's General Report, containing valuable information concerning the labor conditions. 4500 w. Col Guard—Aug. 30, 1901. No. 43136 A.

Ore Dumps.

The Treatment of Ore Dumps in Cornwall. Edward Skewes. Describes the present conditions of the tin mining districts of Great Britain, and the working of the dumps for the lead and silver, and the various other products formerly considered valueless. 800 w. Eng & Min Jour—Sept. 14, 1901. No. 43183.

Ores.

Some Principles Controlling the Deposition of Ores. C. R. Van Hise. Concluding contribution of Prof. Van Hise to the discussion of his paper. 7400 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 43292 D.

Pan-American.

Mining at the Pan-American Exposition. A description of the geological and mining exhibits. Ill. 4500 w. Mines & Min —Sept., 1901. No. 43093 C.

Prussia.

The Development of Mining in Prussia in 1900 (Versuche und Verbesserungen beim Bergwerksbetriebe in Preussen während des Jahres 1900). Discussing especially explosives and coal cutting machinery. 1800 w. Glückauf—Aug. 17, 1901. No. 43458 B.

Rock Drill.

The Triumph Rock Drill of the Ruhrthaler Machine Works (Die Gesteinsbohrmaschine "Triumph" der Ruhrthaler Maschinenfabrik). Describing an improved form of reciprocating pneumatic rock drill for mining. 1500 w. 1 plate. Glückauf—Aug. 24, 1901. No. 43459 B.

Safety Clutch.

Hydraulic Brake Safety Clutch for Mine Cages. R. A. Henry, in *Glückauf*. Illustrated description of the apparatus and its operation. 1100 w. Col Guard—Aug. 23, 1901. No. 43043 A.

Shaft Sinking.

Shaft Sinking at Ronnenberg, Hannover. (Das Schacltabteufen bei Ronnenberg, Hanover). H. Wiese. Describing the application of the Poetsch freezing process to deep shaft sinking. 2000 w. Glückauf—Aug. 24, 1901. No. 43460 B.

Smelting.

Chromite as a Hearth-Lining for a Furnace Smelting Copper Ore. William Glenn. Describes a chromite cupola-bottom which has done good service for nearly two years. Ill. 1800 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 43295 D.

Views of an Old Smelter in the State of Morelos, Mexico. C. W. Pritchett. Illustrations and brief notes. 600 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43299 D.

Telluride Quadrangle.

Recent Geological Phenomena in the "Telluride Quadrangle" of the U. S. Geological Survey in Colorado. H. C. Lay. A record of observations, made during eighteen years, of local phenomena. 3500 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43291 D.

Zinc Mines.

The Missouri and Arkansas Zinc-Mines at the Close of 1900. Eric Hedburg. Describes the situation of this industry, reviewing briefly the history and giving statistical information. 9500 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 43289 D.

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MISCELLANY.

Banxite.

The Occurrence of Banxite in Colorado and Wyoming and Its Utilization. J. Ohly. Information concerning these valuable deposits. 1100 w. Min Rept—Sept. 12, 1901. Serial. 1st part. No. 43261.

Biography.

Biographical Notice of Richard P. Rothwell, C. E., M. E. R. W. Raymond. 5500 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 43297 D.

Minerals.

Colonial Minerals at the Glasgow Exhibition. The present article notices the mineral products of most interest from Rhodesia and Queensland. 2300 w. Col Guard—Aug. 23, 1901. Serial. 1st part. No. 43044 A.

Petroleum.

Petroleum and Natural Gas in Kansas. Erasmus Haworth. Considers the geographical extent, the methods and expense of drilling, and the business methods. 1800 w. Eng & Min Jour—Sept. 28, 1901. No. 43390.

Petroleum in Western North America. Arthur Lakes. Describes the various conditions under which it occurs and where it may be expected. 3800 w. Mines & Min—Sept., 1901. No. 43097 C.

The Petroleum Fields of Wyoming. W. C. Knight. This first article of a series reviews the early history, and gives a general statement concerning the occurrence of petroleum in this state. 1800 w. Eng & Min Jour—Sept. 21, 1901. Serial. 1st part. No. 43361.

The Uses of Petroleum and Natural Gas in Kansas. Erasmus Haworth. An account of the various enterprises established in Kansas on account of the abundant and cheap fuel found there; the amount of gas they consume, etc. 1200 w. Eng & Min Jour—Sept. 14, 1901. No. 43182.

See Mechanical Engineering, Steam Engineering.

Quarrying.

A Central Compressed Air Power Plant for Quarrying. Illustrates and describes a recently installed plant for furnishing power to drive machinery in quarries. 1500 w. Ir Age—Sept. 5, 1901. No. 43061.

Tin.

Recovery of Tin From Tin-Plate Clippings. Jas. W. Worsey. Describes the process used by the writer, and the results. 1100 w. Min & Sci Pr—Sept. 21, 1901. No. 43388.

Some Methods of Tungsten Determinations. George M. Parker. Abstract of a graduation thesis at the Univ. of Arizona. An explanation of methods, and results. 1500 w. Min & Met—Sept. 1, 1901. No. 43080.

RAILWAYS AND TRAMWAYS.

CONDUCTING TRANSPORTATION.

Accidents.

Train Accidents in the United States in July. Monthly statement of accidents in the order of the dates of their occurrence. 3000 w. R R Gaz—Sept. 27, 1901. No. 43396.

High Speed.

The Cost of Running Trains at High Speed. John G. Crawford. A study of the results of tests made on the Chicago, Burlington & Quincy R. R. during July, 1900. 1200 w. Eng News—Sept. 12, 1901. No. 43193.

Scotland.

Notes From Scotland. Alexander F. Sinclair. Discusses the acceleration of speed in London to Edinburgh trains, and the Knottingley accident. 1100 w. Loc Engng—Sept., 1901. No. 42995 C.

FINANCIAL.

Fares.

Cheaper Railway Fares. Horace Bell. Abstract of a paper read before the Glasgow Congress. Discusses the need of reduction in the United Kingdom. 1600 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43237 A.

Rating.

Rating of Street Tramways. J. Neville Porter. Some cases of British law, and a discussion of the methods of valuation. 2300 w. Tram & Ry Wld—Aug. 8, 1901. No. 43086 B.

MOTIVE POWER AND EQUIPMENT.

Air Motors.

The New Compressed Air Motors for City Traction. An illustrated account of the changes and improvements recently made, with report of their successful working. 1800 w. R R Gaz—Sept. 6, 1901. No. 43157.

Burgdorf-Thun.

The Burgdorf-Thun Electric Railway (Le Chemin de Fer Electrique de Berthoud à Thoune). M. Maguin. A general description of this important installation of polyphase traction in Switzerland, with details of the trials. 4000 w. Revue

Gen des Chemins de Fer—Sept., 1901. No. 43434 H.

Cars.

A New Convertible Hopper and Gondola Car. Illustrates and describes a car especially designed for ballasting, which can be changed into an ordinary flat-bottom gondola car capable of carrying 84,000 lbs. of coal. 900 w. R R Gaz—Sept. 20, 1901. No. 43334.

Fifty-Ton Steel Drop-Bottom Gondolas. Illustrated description of cars now building for the Elgin, Joliet & Eastern R. R. 700 w. Am Engr & R R Jour—Sept., 1901. No. 43006 C.

Compounding.

A Review of the Different Systems of Compounding. F. F. Gaines. Reviews the mechanical features. 900 w. R R Gaz—Sept. 27, 1901. No. 43394.

Electric Driving.

Electricity as a Motive Power on Railways. Prof. C. A. Carus-Wilson. Read before the Glasgow Congress. Deals with the economic considerations governing the substitution of electricity for steam as a motive power on railways. 2700 w. Engng—Sept. 6, 1901. No. 43227 A.

Electric Locomotive.

Combined Rack and Adhesion Locomotive (Locomotive à Crémaillère et à Adhérence). F. Barbier. Description of narrow gauge electric locomotive used on the road between Lyons and the plateau of Saint-Just. There are two sets of motors for the rack and adhesion respectively. 1800 w. Génie Civil—Aug. 31, 1901. No. 43405 D.

Europe.

European Railroad Jottings. Charles Rous-Marten. Discusses late locomotives in Great Britain. 1800 w. Loc Engng—Sept., 1901. No. 42996 C.

Fender.

Movable Fender for Tramways (Chasse-Corps Mobile à Déclenchement pour Tramways). Ch. Dantin. The fender is normally carried on rollers, close to the ground, but can be lifted over obstructions. 1200 w. Génie Civil—Sept. 7, 1901. No. 43409 D.

Fuel Oil.

Some Details of Fuel Oil Burners. Extracts from a paper of W. N. Best recording his experience, and describing his apparatus. Ill. 2600 w. Am Engr & R R Jour—Sept., 1901. No. 43008 C.

High Speed.

Electric High Speed Railways (Elektrische Schnellbahnen). W. Reichel. An account of the equipment of the electric railway to make 200 kilometres per hour on the Marienfeldezossen line. Serial, Part I. 5000 w. Elektrotech Zeitschr—Aug. 22, 1901. No. 43454 B.

High-Speed Electric Railway Car of the Allgemeine Elektricitats Gesellschaft, Berlin. O. Lasche. An illustrated account of the arrangements being made for the study of the economy of the electric system as compared with steam, and the speed possibilities. The trials will be made on the military railway track, Berlin-Zossen. 4500 w. Elec Wld & Engr—Sept. 14, 1901. No. 43188.

The High-Speed Cars of the General Electric Company of Berlin (Der Schnellbahnwagen der Allgemeinen Elektricitäts-Gesellschaft, Berlin). O. Lasche. A very complete description of the electric motor cars and machinery for the new express railway, to make 200 kilometres an hour. Two articles. 7000 w. 1 plate. Zeitschr d Ver Deutscher Ing—Sept. 7, 14, 1901. No. 43417 each D.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour. Walter Reichel. Describes a high-speed railway and experimental cars, power requirements, and details of a trial road about 14¼ miles in length. Ill. 4000 w. Elec Wld & Engr—Sept. 7, 1901. No. 43160.

Locomotive Efficiency.

The Efficiency of Locomotives (Rendement des Locomotives). J. Nadal. A discussion of the mathematical formula for efficiency, with applications to various types of simple and compound locomotives. 15000 w. Rev Gen des Chemins de Fer—Sept., 1901. No. 43436 H.

Locomotives.

A Locomotive Curiosity. Brief illustrated description of an engine built in 1846 and but recently withdrawn from service in England. 500 w. Sci Am—Sept. 28, 1901. No. 43378.

American and English Locomotives in Japan. Clippings from the Kobé Herald giving views of the Sanyo Ry. Co. relative to the respective merits of English and American locomotives. 1600 w. U S Cons Repts, No. 1137—Sept. 12, 1901. No. 43150 D.

American Locomotives in Europe. Discusses the attitude of Germany and the countries where opportunities are most promising. 1200 w. U S Cons Repts, No. 1132. Sept. 6, 1901. No. 43046 D.

A New Coal Locomotive. Sectional views and elevation with description and dimensions of an eight-coupled goods engine. 900 w. Engr, Lond—Sept. 6, 1901. No. 43222 A.

Atlantic Type Passenger Locomotives—Chicago, Milwaukee & St. Paul Ry. Illustrates the principal features of the design and the boiler and frame details and

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gives the general specifications. 500 w. R R Gaz—Sept. 20, 1901. No. 43332.

Consolidation Mountain Pushing Locomotive. Illustrated description of an engine for service on the Atchison, Topeka & Santa Fe Railway. Dimensions are given. 500 w. Am Engr & R R Jour—Sept., 1901. No. 43007 C.

Four Cylinder Compound Express Locomotive (Locomotive Compound à Grand Vitesse à Quatre Cylinders). D. Bellet. Illustrated description of the 66 ton express compound locomotives of the Italian Adriatic Railway. 2000 w. Revue Technique—Aug. 25, 1901. No. 43411 D.

Four-Cylinder Tandem Compound Locomotive. Half-tone drawings with description and general dimensions. The type has been found satisfactory after a year of service on the Northern Pacific Ry. and an order for 26 engines has been given. 1600 w. Am Engr & R. R. Jour—Sept., 1901. No. 43005 C.

Locomotives of the Nineteenth and Twentieth Centuries. S. M. Vauclain. Read before the New England R. R. Club. An interesting illustrated review of the history of locomotive building, with questions and replies following. 10200 w. Loc Firemen's Mag—Sept., 1901. No. 43059.

Narrow-Gauge Side-Track Locomotive for the Egyptian Delta Railway. Illustrations of a four-coupled engine with a four-wheel bogie in front. Brief description. 250 w. Engng—Sept. 6, 1901. No. 43225 A.

Schenectady Four-Cylinder Tandem Compound Locomotives—Classes Y-2 and Y-3, Northern Pacific Railway. An illustrated detailed description of a locomotive design of unsual interest, with additional comment. 3200 w. R R Gaz—Aug. 30, 1901. No. 43015.

Some Particulars of the Results of the Compound Locomotive on the Buenos Aires Great Southern Railway. R. Gould. Read before the Inst. of Mech. Engrs. Detailed description of the engines, with tabulated report of coal consumption and cost of repairs. Ill. 1900 w. Inst of Mech Engrs—Glasgow Eng, 1901. No. 43270 D.

Tandem Compound Consolidation Locomotive, Northern Pacific Ry. Illustration and principal dimensions of the Y-2 engines, with description of details. 900 w. Ry & Engng Rev—Sept. 21, 1901. No. 43365.

The Austrian Locomotives at the Exposition of 1900 (Les Locomotives Autrichiennes à l' Exposition de 1900). F. Barbier. Giving detailed dimensions of the engines exhibited, and data concerning their construction and performance. 7000 w. 2 plates. Rev Gen des Chemins de Fer—July, 1901. No. 43433 H.

The English Locomotives at the Exposition of 1900 (Les Locomotives Anglaises à l'Exposition de 1900). R. Godfernaux. With plates showing constructive details of the principal engines exhibited. 5000 w. 5 plates. Rev Gen des Chemins de Fer—Sept., 1901. No. 43435H.

Vanderbilt-Baldwin Consolidation Locomotive—Buffalo, Rochester & Pittsburg Railway. Photograph, drawings and general specifications. 1500 w. R R Gaz—Sept. 13, 1901. No. 43204.

Platforms.

Street Car Platforms. W. E. Partridge. Outlines the development of the modern car from the stage coach, and gives illustrated descriptions of the style and construction of the various platforms in use. 6000 w. St Ry Jour—Sept. 7, 1901. No. 43163 D.

Royal Train.

The Royal Train of the Canadian Pacific. Illustrated description of the train built for the use of the Duke and Duchess of York during their Canadian tour. 800 w. R R Gaz—Sept. 20, 1901. No. 43333.

Staybolts.

Locomotive Firebox Staybolts (Les Entretoises de Foyers de Locomotives). Discussing the practice of the Northern Railway of France with the "Stone" slotted staybolts, designed to secure flexibility with minimum reduction in strength. 1800 w. Revue Technique—Aug. 25, 1901. No. 43413 D.

Tender.

Tender of 6,000 Gallons Capacity—Michigan Central Railway. Illustrated description of a recent design to be used with consolidation engines now building. 800 w. R R Gaz—Sept. 6, 1901. No. 43158.

Train Control.

The Thomson-Houston System of Train Control. Illustrates and describes a train on the extension of the French Western Railway into Paris, which has been recently equipped with this multiple control system. 2200 w. Elect'n, Lond. Sept. 6, 1901. No. 42211 A.

NEW PROJECTS.

Barry.

The Rhymney Branch of the Barry Railway. Illustrates and describes an important new coal line which connects the Barry dock with the coalfields of South Wales. 1800 w. Transport—Sept. 6, 1901. No. 43218 A.

Contest.

The Struggle for the Line from Salt Lake to Los Angeles and San Diego. An account of the progress of work on these contested lines from Utah to Southern California, and the injunction which has

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interrupted the building. Map. 2200 w. R R Gaz—Sept. 13, 1901. No. 43206.

London.

The Rapid Transit Problem in London. Frank J. Sprague. Outlines a scheme for operating the roads electrically under a single complete plan, the abolishment of classes, establishment of one regular rate of fare, &c. Ill. 4000 w. The Engineering Magazine—Oct., 1901. No. 43480 B.

Sudan.

Sudan Government Military Railways. C. B Macauley Abstract of a paper read before the Glasgow Congress Gives details of the Khartoum and Kerma lines, and their equipment 1600 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43238 A.

PERMANENT WAY AND BUILDINGS.

Australia.

Australian Railways. W. C. Kernot. Abstract of a paper read before the Glasgow Congress. A report of the railway system and their condition, with map. 1000 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43236 A.

Brazil.

The System of the Sao Paulo Tramway, Light & Power Company, Ltd. A statement of the conditions to be met with a general review of the situation, describing the electric plant and its construction. Ill. 5800 w. St Ry Jour—Sept. 7, 1901. No. 43165 D.

Curves.

Transition Curves. W. B. Lee. A mathematical study of the cubic parabola. 600 w. Pro Am Soc of Civ Engrs—Aug., 1901. No. 42976 E.

Electric Railways.

Recent Practice in Electric Railway Construction and Operation. Editorial discussion of cost and the construction suitable for the conditions to be met. 2700 w. Eng News—Aug. 29, 1901. No. 43013.

Electrolysis.

See Gas Works Engineering.

Freight House.

A Modern Freight House, Wisconsin Central Ry. Illustrated detailed description of one of the best freight houses of modern construction and its equipment. The building is two-stories. 3300 w. Ry & Engng Rev—Sept. 14, 1901. No. 43263.

Grades.

The Construction of the Benton Cut on the Great Northern Railway, Montana. George H. Herrold. An illustrated account of heavy work accomplished during the past year. 1200 w. Eng News—Sept. 12, 1901. No. 43192.

Joints.

Rail Joints. Extracts from the *Bulletin* of the International Railway Congress, giving the essentials of the discussion of the report on rail joints. 3000 w. R R Gaz—Aug. 30, 1901. No. 43017.

Lap Sidings.

Lap Sidings on the Cleveland & Pittsburgh. L. F. Loree. Reprint of an article published Dec. 26, 1900, which has been inquired for, but was out of print. A statement of the situation and account of the "lap sidings" with diagrams. 2400 w. R R Gaz—Sept. 13, 1901. No. 43203.

Massachusetts Ry.

A Long Electric Railway in Massachusetts. Alton D. Adams. Describes the line to be constructed between Great Barrington and Cheshire. 900 w. Elec Wld & Engr—Aug. 31, 1901. No. 43010.

Norfolk, Va.

The System of the Norfolk & Atlantic Terminal Company. Illustrated detailed description of the plant with report of the service, and the conditions to be met, and the various interests of the company. 4200 w. St Ry Jour—Sept. 7, 1901. No. 43162 D.

Ontario.

The Niagara, St. Catharines & Toronto Railway. E. F. Seixas. An illustrated description of a road changed from steam to electricity. 1500 w. St Ry Jour—Sept. 7, 1901. No. 43167 D.

Overhead Construction.

Dangers from Trolley Wires and Their Prevention. Andrew Jamieson. Abstract of paper read before the Elec. Sec. of the Glasgow Cong. Considers the necessity of the proper protection of trolley wires from contact with other overhead conductors; methods adopted and proposed; the Board of Trade and Post Office regulations, &c., &c. Also editorial. Ill. 5200 w. Elec Rev, Lond—Sept. 6, 1901. No. 43216 A.

Methods of Safety for the Overhead Electric Trolley System. Edward Manville. Discusses the precautions to be taken to ensure solid construction, and methods of ensuring safety if a breakdown should occur. Ill. and discussion. 5400 w. Elec Engr, Lond—Aug. 30, 1901. No. 43134 A.

Roundhouses.

Locomotive Running Sheds; Eastern Railway of France. An illustrated description of these engine houses and their equipment. 900 w. Engng—Sept. 13, 1901. No. 43343 A.

Russia.

The Connection of the Russian Railway System with the Siberian Railway

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(Die Verbindungslinie des Russischen Schienennelzes mit der Sibirischen Eisenbahn). F. Theiss. A description of the Samara-Slatoust railway, connecting the railways of European Russia with Asia. 2000 w. Glaser's Annalen—Sept. 1, 1901. No. 43437 D.

Safety Appliances.

Railway Safety Appliances at the Paris Exposition of 1900 (Die Einrichtungen zur Sicherung des Eisenbahn-Zugverkehres auf der Welbausotellung Paris 1900). G. Rank. A general description of the signalling and other safety appliances exhibited at Paris. Serial. Part I. Zeitschr d Oesterr Ing u Arch Ver—Sept. 13, 1901. No. 43426 B.

Shops.

New Shops at Hannibal, Mo.—Hannibal and St. Joseph Railway. Gives plans, sections and location of machines, with description of the shops and their equipment. 4200 w. R R Gaz—Sept. 13, 1901. No. 43205.

Signalling.

Modern Practice in Railway Signalling. I. A. Timmis. Abstract of a paper read before the Glasgow Congress. Briefly discusses pneumatic and electric systems. 1800 w. Ir & Coal Trds Rev—Sept. 6, 1901. No. 43235 A.

Train Movement Signalling on the Boston Elevated Railway. Howard S. Knowlton. Illustrates and describes the block signal installation, with its interlocking and automatic features. 3300 w. St Ry Jour—Sept. 7, 1901. No. 43164 D.

Steel Ties.

Steel Railroad Ties in Europe. Foster Crowell. A comparison of experimentation in this field in America and Europe. Ill. 4200 w. R R Gaz—Aug. 30, 1901. No. 43016.

Ties.

Study of the Life of Cross-Ties. P. H. Dudley. Illustrated notes dealing principally with the record of 12 years' service of untreated yellow pine cross ties under the traffic of the New York Central & Hudson River Railroad. 5000 w. R R Gaz—Sept. 6, 1901. No. 43155.

Train-Shed.

The Pennsylvania Railroad Train-Shed at Camden. Illustrated detailed description of a rectangular steel structure, accommodating twelve lines of tracks. 1800 w. Eng Rec—Sept. 14, 1901. No. 43267.

TRAFFIC.

Differentials.

Railroad Discrimination Against New York, and the Remedy. Discussion of paper by Abel E. Blackmar. 14800 w Pro Am Soc of Civ Engrs—Aug., 1901. No. 42979 E.

MISCELLANY.

American Railroads.

The Present Position of American Railroads. Thomas F. Woodlock. Extracts from articles written for *The Economist*, (London). 2000 w. R R Gaz—Sept. 27, 1901. No. 43397.

Baggage Handling.

The Mechanical Handling of Baggage (Manutention Mécanique des Bagages). M. Pons. An illustrated description of the conveyors and apparatus for the handling of luggage at the new terminal of the Orleans railway on the Quai d' Orsay, Paris. 6000 w. 2 plates. Rev Gen des Chemins de Fer—July, 1901. No. 43432 H.

Boston Subway.

Boston's New Subway. Willard Winslow. A review of the franchise questions, quoting at length from the Governor's reasons for vetoing the bill. 1800 w. Munic Af—June, 1901. No. 43307 D.

Chicago Franchises.

Street Railways of Chicago. The report of the Civic Federation Committees, including "Analysis of Financial Operations" by Milo Roy Maltbie, and the "Accountant's Report" by Edmund F. Bard. 64000 w. Munic Af—June, 1901. No. 43309 D.

China.

The China Railway Blue Book. Editorial discussion of railway affairs in China, and the attitude of Russia. 3200 w. Engng—Aug. 30, 1901. No. 43143 A.

Indexing.

Indexing Railway Maps and Drawings. R. C. Vial. Describes a system which has proved satisfactory in the drafting-room of the Chicago & Western Indiana R R., based on the decimal system. 5000 w. Eng News—Sept. 5, 1901. No. 43169.

New York Subway.

New York's Subway Policy. William J. Gaynor. A statement of the way the great subway system in New York is being constructed, and a comparison with the scheme proposed for Boston. 2300 w Munic Af—June, 1901. No. 43308 D.

Norway.

Notes on Norwegian Railways. From an article by W. E. Curtis, in the *Chicago Record-Herald*. Information concerning the government railroads in a country where many difficulties must be overcome. 1300 w. Ry & Engng Rev—Aug. 31, 1901. No. 43084.

Railway Development.

English View of American Railway Development. From the London *Saturday* Review. 1200 w. Ry & Engng Rev—Sept. 21, 1901. No. 43366.

We supply copies of these articles. See page 317.

EXPLANATORY NOTE.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. Where no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston, U. S. A.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, U. S. A.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston, U. S. A.
Architect's and Builder's Magazine. *m.* New York.
Armee und Marine. *w.* Berlin.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, Eng.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston, U. S. A.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin Scientifique. *m.* Liege.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.

Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemist & Metallurgist. *m.* London.
Elektrizität. *b-w.* Leipzig.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Horseless Age. *m.* New York.
Ice and Refrigeration. *m.* New York.
Indian and Eastern Engineer. *m.* Calcutta.
Ingeneria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Assn. Eng. Societies. *m.* Philadelphia, U.S.A.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, Mass.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metal Worker. *w.* New York.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* Mexico.
Minerva. *w.* Rome.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Metallurgy. *s-m.* New York.
Mining and Sci. Press. w. San Francisco, U.S.A.
Mining Journal. *w.* London
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. m. Vienna.
Modern Machinery. *m.* Chicago.
Monatsschr. d Wurtt. Ver. f Baukunde. *m.* Stuttgart.
Moniteur Industriel. *w.* Paris.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Wochenschr. f. d. Oeff Baudienst. *w.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Power Quarterly. New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineers' Club. *qr.* Philadelphia, U. S. A.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Quarry. *m.* London.
Railroad Digest. *w.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. ed Agr. *b-m.* Catania.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Telephony. *m.* Chicago.
Tijds. v h Klijk. Inst. v Ing. *qr.* Hague.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a. S.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post-Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Cement.

Directory of American Cement Industries, and Handbook for Cement Users. Edited by Charles Carroll Brown. Size, 6 in. by 9 in.; pp. 645. Price, $5.00. Indianapolis and New York Municipal Engineering Company.

Primarily a directory of makers and users of cement, but preceded by a treatise on the history, manufacture and use of cement with forms of specifications, and data for testing.

Cost Keeping.

Cost Accounts of an Iron Founder. By J. W. Best, F. C. A. Size, demy 8vo.; pp. 110. Price, £0. 2s. 9d. London: Gee & Co., 62 Moorgate st., E. C.

Written from the point of view of the professional accountant rather than the engineer. The most important portion is that dealing with foundry accounts, on which subject there is a dearth of available recorded experience. It is hardly necessary to say that there is no attempt to make use of the card system, but a number of rulings of ledgers, analysis books, time and wages books and similar devices beloved of the professional accountant are given. Foundry managers may, however, glean some ideas from its perusal.

Drawing.

Mechanical Drawing. Written for the use of the naval cadets at the United States Naval Academy. By F. W. Bartlett, Lieutenant Commander, U. S. N. Size, 6 in. by 9 in.; pp. 188; figures, 132. Price, $3.00. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Designed to suppement the work of the instructor by presenting in available form for study the minor points of method. Based on the best practical methods, but referred particularly to the methods in use in the U. S. Bureau of Steam Engineering. The instruction is at first very full, even elementary, lessening as the student advances and noting only new and important points.

Directory.

Kelley's Directory of Engineers, Iron and Metal Trades and Colliery Proprietors of the United Kingdom. New edition. Pp. 1807. Price, £1 10s. 0d. London: Kelly's Directories, Ltd.

In this, the ninth edition of this well-known and standard work of reference, the Channel Islands (Jersey, Guernsey, etc.,) are for the first time included.

Electromagnets.

Electromagnets. Their Design and Construction. By A. N. Mansfield, S. B. Size, 4 in. by 6 in.; pp. 155. Price, 50 cents. New York: D. Van Nostrand & Co.

The outgrowth of an attempt to rewrite T. H. Du Moncel's "Electromagnets; the Determination of the Elements of their Construction." The present book is a collection of formulæ and data for constructing electromagnets for various purposes, drawn largely from the works of S. P. Thompson, Du Bois, and Jackson. The matter is well condensed and presented. The book forms No. 64 of Van Nostrand's "Science Series."

Gold and Silver.

A History of the Precious Metals. By Alex Del Mar, M. E. Second edition, revised. Size, 6 in. by 9 in.; pp. 477. Price, $3.00. New York: The Cambridge Encyclopedia Co.

This is not a rescension of the first edition (brought out by Geo. Bell & Co., London, 1880), but a new work by the same author. It is a most scholarly work—treating the subject not from a metallurgical standpoint, but in its historical, economic, political and philosophic aspects. An exhaustive review of the production and search for gold and its relations to civilization from the earliest times to the looting of Pekin, with constant attention to the theory of money.

Machine Trade.

A Hand Book for Apprenticed Machinists. Edited by Oscar J. Beale. Size, 4½ in. by 6 in.; pp. 141. Price, 50 cents. Providence, R. I.: The Brown & Sharpe Mfg. Co.

An excellent little book designed to supplement oral teaching in the training of apprentices. It does not attempt to confer skill, but certain matters of knowledge which must accompany manual dexterity in the well-trained mechanic. The book is an outgrowth of the needs of the Brown & Sharpe Company, and is a most interesting development of what is now generally

known as "American practice" in the treatment of workshop employees.

Mechanics.

Congrès International de Mécanique, 1900. Three volumes. Size 9 in by 12 in. Vol. I.; pp. 546. Papers presented at the Congress; Vol. II., pp. 94, Report of Transactions at the Meetings, July 19-25, 1900; Vol. III., pp. 300, Written Communications and Reports. Three Volumes complete, 40 francs. Paris: Vve Ch. Dunod.

The complete report of the remarkable congress of mechanical engineering held in the Conservatoire des Arts et Métiers in connection with the Paris exposition. The papers discuss the most important technical problems of the day, including the arrangement of mechanical laboratories, hydraulic motors, internal-combustion motors, steam turbines, automobiles, electric driving, works administration, etc.

Mill Buildings.

Mill Building Construction. By H. G. Tyrrell. Size, 6 in. by 9 in.; pp. 40. Price, $1.00. New York: The Engineering News Publishing Co.

A brief statement of the principles of design and methods of construction which the author has found best for this class of structure. Chapter I deals with loads, Chapter II with general design and plans, Chapter III with materials of construction and structural details.

Navigation.

Tables Condensées pour le Calcul Rapide du Point Observé. Par E. Serres, Lieutenant du Vaisseau. Size 9 in. by 12 in. Price 2 fr. 75 c. Paris: Gauthier-Villars et Fils.

A series of simplified tables for the three fundamental calculations required in navigation: Altitude, latitude, and horary angle. The tables are condensed in such a convenient manner as to enable the highest degree of rapidity to be made in the work of computation, no table occupying more than one or two pages, no auxiliary tables being required except one of the ordinary angular functions.

Price Book.

Architects' and Engineers' Price Book. By T. E. Coleman, F. S. S. Pp. 294. Price, £5 0s. 0d. London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain.

This work is intended to afford assistance to those who from time to time must be prepared to determine (often at a moment's notice) the approximate cost of various buildings and works which are in the preliminary stages or for which only general schemes and designs have been prepared. A list showing the actual cost of a few representative buildings and works is added as an appendix.

Smokeless Powder.

Smokeless Powder, Nitro-Cellulose, and Theory of the Cellulose Molecule. By John B. Bernadou, Lieutenant, U. S. N. Size, 5 in. by 7½ in.; pp. 200. Price, $2.50. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

A collection of translations of important papers by MM. Vieille, Mendeleef, and Bruley, with an account of experiments made by the author and a discussion of the development of smokeless powder condensed from his lecture before the U. S. War College. A valuable contribution to the study of smokeless powders.

Thermodynamics.

Notes on Thermodynamics. By H. W. Spangler. Size, 5 in. by 7½ in.; pp. 69; figures, 24. Price, $1.00. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

The method followed is for the most part the presentation of problems, with explanatory notes and discussions on typical solutions. The author, who is Whitney Professor of Mechanical Engineering in the University of Pennsylvania, presents the volume not as a work of reference but a text book, prepared after consultation of all the later writers, in which use has been made of whatever seems the most satisfactory method with a view of covering the theoretical side of thermodynamics more rapidly than was possible with the aid of pre-existing books.

Trade Marks.

Trade Marks. By Ernest Salaman. Pp. 16. Price, one shilling. London: Mercantile Publishing Syndicate, Ltd., 30 Walbrook, E. C.

A pamphlet dealing with the English law of trade marks, particularly reviewing the cases of "Camel Hair Belting," "Cellular Clothing," "Dolly Blue," and "Solio" photographic paper, with interesting comments on these recent decisions and the practice of the Patent Office as regards registration of "invented" words.

Works Management.

The Management of Engineering Workshops. By A. H. Barker. Size, 8vo. Price, £3 3s. 0d. London: Institution of Junior Engineers.

The substance of a series of lectures before the Institution of Junior Engineers, with the resulting discussions, is given in this excellent and practical work. While not necessarily agreeing with all the views of the author or his critics, we have no hesitation in saying that the volume should be read by all engineers interested in the adoption of modern methods of organization and management. It is full of practical matter that can hardly fail of being turned to account.

IMPROVED MACHINERY

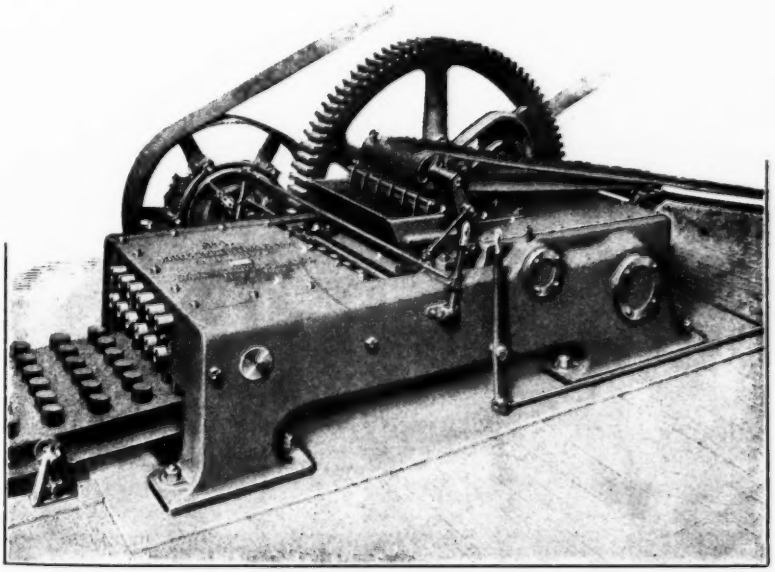
New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Briquetting—Its Progress and Commercial Advantages.

BRIQUETTING, or the putting into compact solid block form, of fine mineral ores has become more and more a part of metallurgical practice in the United States within the last five years. While the briquetting of coal has been carried on to a very larg extent in European countries, the briquetting of fine mineral ores has not had their attention, and it has remained for American ingenuity to bring this industry to a commercial basis.

There are three distinct fields for briquetting, that of coal and coke dust, fine ores and flue dust, and precious metal ores. Only one of these fields has really been developed in this country, and that is the briquetting of precious metal ores for use in the smelter. Taking the fine roasted ores, concentrates, slimes, flue dust, etc., these by putting into briquette form can be put in the smelter to advantage, whereas in their fine condition they would either be impossible to use or cause annoyance and expense. Briquetting is doing away in many instances with matting or intermediate furnaces, which have been heretofore used for the purpose of putting the fine material into slag or matte form that it might be used in the smelter. The need of briquetting is recognized by and is being done in some form by almost every prominent smelting concern in the country.



In addition to briquetting of precious ores when one stops and considers the immense amount of fine ore, flue dust, magnetic concentrates, and iron sand ore that would be immeasurably benefitted by briquetting, and the millions of tons of anthracite coal dust in the culm banks of the anthracite regions and the millions of tons of bituminous slack and dust that at many points is not marketable and all of which would be made valuable products by briquetting, then one can form some idea of the magnitude of the field for briquetting.

It may be very much in advance of the present time, and seem possibly an impossibility, but why should not the process of briquetting be so cheapened and perfected as to briquette all of the Mesaba ores at the mines? Think a moment of what this would mean. These ores carry an average of about 15 per cent. of moisture on which freight is paid from the mines to the furnace. If the advantages will overbalance the cost, why should not all of this fine ore be dried at the mines, briquetted, and in that form put in the furnace? Then there would be no limit to the percentage of Mesaba ores that could be successfully used without the many dangers and objections that now come from the use of more than 45 per cent. in the furnace burden.

The briquetting of magnetic concentrates, and separated iron sand ores, would furnish a desirable product for blast furnace use which is now used to only a limited extent.

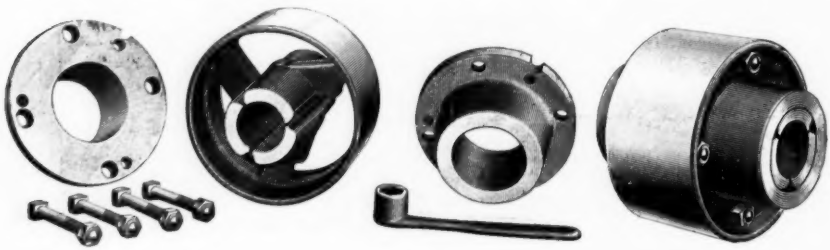
The briquetting of coal products in this country has been held back since the development of the proper machinery by the high cost of pitch, which is the binder most generally used in Europe. There are other bonding agents, however, that have been and are being perfected, and there are several syndicates with large capital backing them which are very seriously looking into the subject with a view of erecting briquetting plants in this country for the briquetting of coal products. The large demand of European countries on this country for supply of fuel and the very many inquiries in the last six months for briquette fuel will undoubtedly tend towards the erection of plants in this country to supply European needs in this line.

The White briquetting press, improved up to 1901, as will be seen by the illustration, is a horizontal reciprocating multiple plunger press. The capacity of a machine of this character ranges from one turning out 150 briquettes per minute, each 3½ inches in diameter by 2¼ or 2½ inches thick, weighing in flue dust or concentrates from 2¼ to 3 pounds each, thus giving a capacity of 100 tons per ten hours, down to a machine with a capacity of but 33 tons per ten hours. The standard speed is 25 strokes per minute. The largest machines made weigh 32,000 pounds and cover a floor space of 12x13 feet 6 inches, and 5 feet 8 inches in height.

This briquetting press is manufactured by The Henry S. Mould Co., Pittsburg, Pa., who will be glad to furnish the fullest details on request.

Davis Patent Compression Coupling.

THE illustration herewith shows a new invention in the way of a shaft coupling. Each piece of the coupling is shown separately, and the principle will be readily understood. The coupling, as will be seen, consists of the coupling proper, which consists of a rim with three arms set on an angle, which are attached to the hub. After the hub is bored, the hub is cut endways in three pieces, each piece being supported by an arm.



The outside of the hub is turned tapering and the compression flanges are bored tapering. When these flanges are put on the hub and drawn together by bolts, as shown, it furnishes a compression that brings the shaft into perfect alignment.

By the use of the coupling, as shown, no keys are required and the compression, when the coupling is bolted together is sufficient to hold the shaft securely under the heaviest strain. Any ordinary workman can put the couplings on the shaft and secure them properly in a very few minutes.

This will be a great convenience to the average dealer who handles shafting, as the couplings can be shipped out with as little trouble as the shafting, and when received by the customer they can be put up without any extra fitting.

The coupling can be secured through any machinery or hardware dealer in the United States or will be shipped direct from the factory. For further particulars address the W. P. Davis Machine Co., Rochester, N. Y.

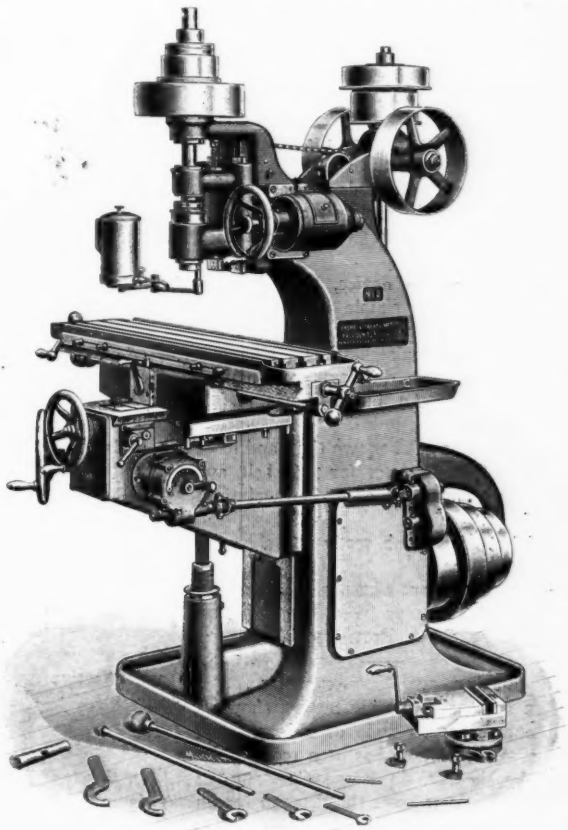
Vertical Spindle Milling Machine.

THIS type of machine is being more appreciated as the peculiar advantages it offers are constantly being better understood, and for many kinds of work is preferable to a machine with a horizontal spindle.

The use of a machine of this type permits the operator to more easily see the work, and more readily follow any irregularity in the outline of the work, as in profiling, cutting irregular slots in a surface and work of a similar character. All levers, hand wheels, etc., for controlling the various movements of the machine are conveniently placed, thus enabling adjustments to be quickly made.

The spindle has a hole its entire length, and runs in bronze boxes, the bearings are ground and lapped. The lower box is provided with means of compensation for wear. With two speeds of counter, 12 changes of speed are obtained, as follows:—using main cone, 6 speeds, varying from 85 to 504; and using the high speed cone, 6 speeds varying from 212 to 1260 revolutions per minute. The lower end of the spindle has a No. 10 taper hole. The arbors and cutters can be held by a bolt passing through the spindle. Distance from centre of spindle to column 16".

The spindle head has a vertical move-



ment of 4" with fine hand feed, and quick return operated by the same hand wheel, often serving the purpose of a drill press on work already in position for milling. The spindle pulleys are carried on a separate sleeve, thus obviating any strain on the spindle due to the pull of the belt.

A stop, with micrometer adjustment, is provided on the left side of the head for controlling the depth of cut.

The cone has three steps for 3" belt.

The table, including oil pans and channels, is 45" long, 10¼" wide, has a working surface 37½" x 10", 3 T slots ⅝" wide, an automatic transverse feed of 12", and can be lowered 16" from end of spindle. The elevating screw is of improved design and does not run below the base of the machine; the thrust is taken by ball bearings. The greatest distance from end of spindle to top of table is 20".

The feeds of table, longitudinal 26", transverse 12", are positive and automatic in either direction, and can be automatically released at any point, or reversed by a simple movement of a lever on the front of the saddle. A lever on the right of the knee serves to reverse all feeds. There are 12 changes of feed in each direction, evenly graded from .005" to .125" to one revolution of the spindle.

The change feed device, located inside of the upright, is simple in construction and positive in action. The changes of feed are obtained by unlatching and sliding a lever that sets the different combinations of feed gears. An index shows plainly the desired feed.

The counter-shaft has two tight and loose pulleys, 10" in diameter for 3½" belt, and should run about 120 and 360 revolutions per minute.

Weight of machine ready for shipment about 3675 lbs.

Net weight, about 2800 lbs.

Further details may be had from Brown & Sharpe Mfg. Co., Providence, R. I.

Shavings and Dust Separator.

THE accompanying illustration shows a new and improved style of shavings and dust separator, which has been recently devised by the Buffalo Forge Company, of Buffalo, N. Y., to meet the demand for an efficient apparatus of this nature. The operation of this separator depends upon the centrifugal force of the refuse material. These particles, upon entering the inlet at the top, are discharged with a whirling motion, and being heavier than the air, are thrown by their centrifugal force against the outer shell, down which they pass in a spiral path to the discharge orifice. The air changes its direction abruptly, passing at a very low speed out of the orifice in the top, and owing to its greatly lessened velocity is no longer able to carry along the shavings and dust. By these means separation is effectively accomplished. This separator is built in a large range of sizes. It is constructed throughout of steel plate of heavy gauge, securely riveted, and is sufficiently stiff to resist

strains of any reasonable magnitude. When the woody refuse is to be used for boiler firing, the separator may be located to discharge into a bin adjacent to the boiler room. In all cases where exhaust fans are employed to remove the shavings, sawdust or refuse material of woodworking and other processes, such a device is a simple and effective means for unloading the air currents.

Duplex Boiler Shell Drill.

IN this type of machine, as in the former rope driven type, the boiler shell is placed horizontally upon four or six rollers in

front of the tool, then by placing the spindles horizontally at the height of the centre line or pointing up towards the centre line, and turning the shell all the holes in the circular seams can be reached, and by moving the upright along the bed all the holes in the longitudinal seams can be drilled.

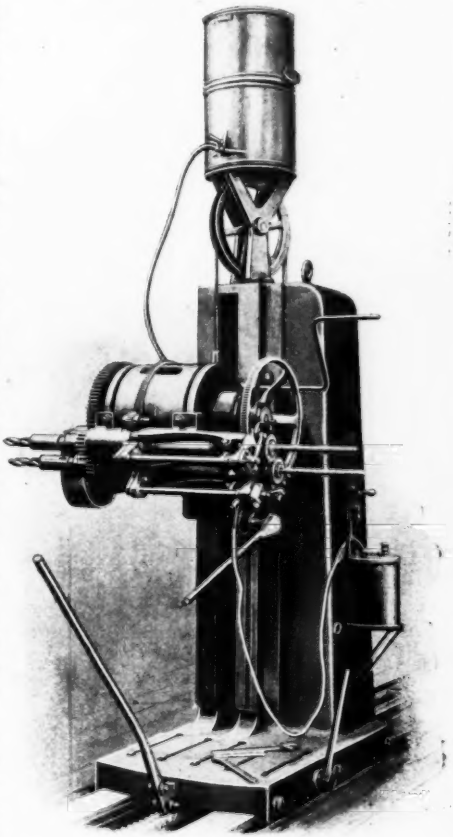
The machine, as seen in accompanying cut, consists of a cast-iron bed, made of any length desired, on which is mounted an upright the weight of which is carried upon roller bearings, thus enabling it, by means of a lever and ratchet arrangement, to be easily moved along the bed.

The upright carries a swivel slide to which is fastened the drilling head, the whole being counter-weighted so that it can be easily moved vertically upon the upright by means of a rack and pinion operated by a ratchet wrench.

The drilling head consists of the electric motor around the circumference of which are moved and fastened the spindle frames; the motor being of the enclosed multipolar type, is well adapted to boiler shop use, as it is practically dust and waterproof, it is furnished with roller bearing and end ball thrust bearings so that it can be run in the vertical position, and is furnished with a starting and controlling switch, by which in connection with the back gearing the spindles can be run at ten different speeds for different sized drills. The spindle frames are held firmly to the motor by V gibbs at the ends and bolts locked in T slots around it. They are easily moved in setting by means of a ring gear around the motor and pinions on the spindle frames, by which they can be moved either singly or both together.

The spindles can be grouped in either the horizontal or the vertical plane, or in any position between them, by which arrangment both spindles are always operative in drilling all the holes in the shell. Each spindle has an independent automatic feed arrangement, and there is a quick hand feed by which either spindle can be advanced separately or both together, this hand feed with a sliding sleeve socket can be used in tapping and screwing in stay bolts.

The starting and controlling switch and rheostat is substantially made and coated with a water-proof material so that it will withstand moisture; it is furnished with a magnetic circuit breaker to guard against overloads, which is also used as a main switch so that the current is always broken on a knife switch, thus preventing any burning of the contacts of the controller; by the arrangement of the controller a difference in ratio of speed of from one to two



is obtained, and this variation is accomplished in such a manner that the full power of the motor is retained at all speeds; the controller is also furnished with a reversing switch, by which the spindles of the drill can be reversed in such work as tapping.

The drilling head, being mounted on a

swivel slide, can be turned from 45 degrees above the horizontal to the vertical position and thus can be used in drilling plates in the flat.

The machine has been carefully designed in view to rapid handling, so that the operator standing on one side of the upright has full control over the movements of the machine.

Additional uprights complete with drilling head can be furnished, increasing the capacity of the machine.

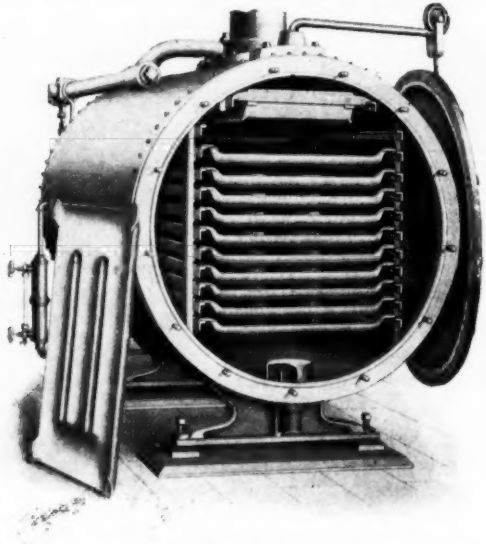
The horizontal range is 20 feet, vertical range of drilling head on upright is 4½ feet, the spindles in the highest position being 7 feet above the base of the tool; the drilling head is fitted with spindles 2″ in diameter, bored to fit a No. 4 Morse taper shank; the spindles have a traverse of 15″ and are furnished with an automatic feed arrangement giving from .004 to .07 of an inch advance per revolution. They can be run at ten different speeds between 35 and 150 revolutions per minute, and can be adjusted between 4″ to 17″ between centres.

Additional details may be had from Thos. H. Dallett & Co., Philadelphia, Pa.

New Hoppes Feed-Water Heater.

We illustrate on this page a new form of feed water heater recently brought out by the Hoppes Manufacturing Co., of Springfield, O. This heater is intended to be used where the water contains acids or other corrosives, and is not intended to take the place of the company's regular form of heaters with steel pans where the water is neutral or contains large quantities of lime and other solids. The illustration clearly shows this heater and it is only necessary to say that the pans and all parts with which the feed water comes into contact are made from cast iron and where bolts are used they are bronze.

In designing this heater, use was made of the well-known Hoppes system of flowing water along the underside of the pan in thin films in such manner that the exhaust passing through the heater would come into direct contact with the water. The pans in this heater are cast in one piece and are in form a multiple of trough shape sections, joined at each end by a section of the same form and provided at each corner with lugs for supporting the pan on the ways in the heater. The pan shown, setting beside the heater in cut will give a good idea of the shape used in this construction. It will be noticed that the water will flow over the edges of the pans and also through the slots in the same, the water flowing over the sides of the pans or edges will follow the



underside of the pan to the lowest point before dropping into the next pan below, and so on over each pan until it reaches the reservoir at bottom. The exhaust steam passing through the heater comes into direct contact with the water flowing over the pans and therefore can impart its heat to the water without heating through the metal of the pans or lime deposited thereon.

The comparatively flat form of this pan permits of about twice the amount of surface being put into a heater of a given size as compared with the original form and as a smaller shell can be used much saving of space is effected. This heater is provided with a hooded outlet for the pump suction which acts as a skimmer, and when desired a filter is also provided. A large and efficient oil catcher is located in back head of heater and a float and balanced valve is provided for regulating the feed water inlet. It will be noticed that the entire head of the heater is removable so that access may be easy to all parts of the heater for cleaning or examination and a crane is provided for removing this head as shown in the engraving.

A trap is also provided for the oil drips from overflow when the heater is used in connection with a heating system.

Heaters of this construction have been manufactured by the Hoppes Company for a little less than one year, but it has now in use machines ranging in size from 150 H. P. to 7,000 H. P., all of which are giving excellent results.

The large reservoir at the bottom of this heater makes it well adapted to be used as a heater and receiver where installed with a heating system.

An Improved Swing Saw.

THE illustration shows a machine for general work that possesses the requisite qualifications to make it prove of advantage to any who have use for such a tool and who will carefully examine the merits and points of advantage embodied in the construction of this.

Among the features on this machine and that make it superior in range of work and workmanship to any of its class at present on the market are the following: The patent adjustable balance weight, the way it is attached and manner of operation, gives the machine great advantage for doing rapid work, as it helps the operator both ways, and when the cut is finished swings the saw clear off the lumber without any effort on his part. The hangers are very perfect. The frame swinging on the outside of the boxes, with the countershaft inside these, insures very perfect execution, freedom from wear and impossible to get out of line, as it swings not on the countershaft, but on the boxes of the hanger. The steel mandrel is fitted with an expansion

device to fit blades with different holes. The patent shield on the saw prevents all possible accidents. The frame of the machine being broad at the base insures great accuracy.

Further particulars of this machine, together with lowest terms, will be willingly furnished by the manufacturers, J. A. Fay & Egan Co., of 212-232 West Front street, Cincinnati, Ohio.

Industrial Notes.

Two very well planned and well arranged series of lectures will be given this winter at the New York Trade School, First avenue and 67th street, adapted particularly to electrical journey and practical steam-engineers. The purpose is distinctly to make simple talks on practical problems, illustrated by clear and easily understood experiments, so as to aid the journeyman worker in gaining a knowledge of modern methods and modern apparatus sufficient to make him an intelligent follower of his craft. They will be useful and valuable helps, without the depth and difficult technicalities too often found in lectures of this kind.

The course in steam-engineering is as follows: Oct. 23, The Boiler—Water, Fire, and Return Tubular; Nov. 6, The Boiler-Bursting Pressure, Tests, and Methods of Calculating; Nov. 20, Grates and Grate Bars; Dec. 4, Flues, Draughts, and Fires; Dec. 18, Boiler Capacity; Jan. 8, Low-Pressure Slow-Speed Engines; Jan. 22, High-Pressure High-Speed Engines; Feb. 5, Calculating Horse Power, Piston Speed, etc.; Feb. 19, Governors, Valves, etc.; Mar. 5, Direct-Coupled Electric-Lighting Units.

In the course for electrical workers the schedule is: Nov. 1, Volts, Amperes, Ohms —A Simple Demonstration of the Electrical Units; Nov. 15, Alternating and Continuous Currents; Nov. 29, How to Calculate the Size of Wires; Dec. 13, Dynamos and Generators; Jan. 3, Electric Motors; Jan. 17, Methods of Testing Motors, Dynamos, etc.; Jan. 31, Wiring Systems; Feb. 14, Switchboards, Rheostats, and Circuit Breakers; Feb. 28, Chemical Electricity, Primary and Storage Batteries; Mar. 14, Isolated Plants.

After every lecture, questions by the audience will be fully answered. Tickets for either full course of ten lectures are $1.00, and may be obtained from the New York Trade School. The lectures will be conducted by Mr. Arthur A. Hamerschlag, and his remarkable ability as an instructor and a clear and satisfactory demonstration assures their value to the hearers.

Charles A. Schieren & Co., New York, have been awarded a gold medal at the Pan-American Exposition for oak bark tanned leather belting and belt leather. Their exhibit there was in the machinery section, and it consisted of an oriental kiosk, made from the same material as the Exposition buildings, one of the artistic features of the decoration being the wainscoting reaching from floor to ceiling on all sides, and made from samples of leather belting, showing the various grades of leather and fastening at laps of belting used by this house. The exhibit proper consisted of a 72" 3-ply leather belt, 165 feet in length, made for the People's Tramway Co. of Putnam, Conn., which is undoubtedly the largest 72" belt ever made in this country. In addition to this large belt, they exhibited rolls of smaller sizes, showing the different grades manufactured by them, and in the electric power plant of the Exposition they have had a 20" double and seven or eight 12" double leather belts running ever since the Exposition began. These belts are treated with Leatherine, a composition which renders the belts impervious to dampness and water and gives the belt more dynamic power than a belt which is not so treated. A practical demonstration of the value of Leatherine occurred during the heavy storm recently, when the roof of the Exposition power house leaked and wet all of the belts in operation. The only belts that held together at the laps and were not rendered useless were those made by Chas. A. Schieren & Co.

The Morris Machine Works, Baldswinville, N. Y., have been awarded a gold medal at the Pan-American Exposition for their exhibit of centrifugal pumps and steam engines.

The London office of the Buffalo Forge Company recently opened at 39, Victoria street, London, S. W., under the management of D. W. Roper, M. E., has recently closed an important contract in connection with the new plant of the British Westinghouse Electric and Manufacturing Company, at Old Trafford Park, Manchester, England.